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ABSTRACT

This technical report presents the results from a special physiological study of women performed at the Johnson Space Center in 1976-77. The purpose was to establish a substantially large (98 subjects) normative data base taken from a general population of working women who might be considered representative of future women astronauts. The data sets consist of medical historical, clinical, anthropometric, and stress response determinations and measurements which would be relevant to human space flight and hence helpful in establishing appropriate medical screening criteria (types of tests and their normal values) for selecting women astronauts. The stressors chosen were lower body negative pressure and static standing (both orthostatic) and treadmill exercise (ergometric). Most methods were identical to or similar adaptations of those protocols used in testing Apollo and Skylab program crewmen.

Data are provided in two formats: (1) original individual values which are amenable to cross correlations and subsequent analyses in any subsets which might be of interest and (2) statistical summaries and correlations suggested by the variables themselves and by certain questions which concern investigators of the human responses to microgravity. Of notable comment is the very great similarity of many characteristics of the women subjects of this study generated before selection of any American women astronauts and the corresponding characteristics of those women astronauts now regularly flying among Shuttle space crews.

Acknowledgements

The authors wish to express their appreciation to the following personnel for their dedicated support in the conduct and prepartion of this study: William Crozier, Kathy Tamer, John Donaldson, and Mary Taylor of Krug International (formerly Technology Inc.); John F. Zieglschmid, M. D. and Charles K. LaPinta, M. D. of the Johnson Space Center; and Mary Anne Frey, Ph. D., William Alford, Susan Loffek, Mark Antiel, and William Moore of The Bionetics Corporation.

The authors also thank the many subjects whose enthusiastic and wholehearted voluntary participation in all aspects of the study protocols made acquisition of this knowledge base possible.

Product Disclaimer

This report, in whole or in part, may not be used to state or imply the endorsement by NASA or by NASA employees of a commercial product, process or service, or used in any other manner that might mislead.

Dedication

This publication is dedicated to the memory of R. L. Johnson, MD, FACC, NASA cardiologist and clinical researcher, for his wisdom and mentorship over many years and for his insight and practical contributions to our understanding of human responses to microgravity.

INTRODUCTION

Concerns for the physiological responses of women did not appear in NASA operations until after the historic Skylab missions. In a symposium held in August, 1974, the National Aeronautics and Space Administration reported medical results (25) of its three successful Skylab missions, which had concluded with the 84-day mission on February 8, 1974. In July, 1975, the last of the Apollo-class missions was flown jointly with the Soviet Soyuz 19 mission (35). At this point in time no American women had ever been selected as astronauts. The next U. S. program involving humans in space, however, was to employ the reusable Space Shuttle in which many more individuals with widely varying disciplines and physiological states were envisioned to be among the crews. Women were to be included in the next astronaut selection which took place in 1978. This was the eighth serial group selected by NASA beginning with the first cohort of seven Mercury astronauts.

Thus, early in 1976 a study was initiated at the Johnson Space Center to determine, from a selected group of women, baseline physiological responses which would be pertinent to human space flight. It was intended that results from that work might contribute to medical design of the subsequent selection process, both in the choice of screening tests and in determining reasonable envelopes of normal values for women. It could also serve as reference for future studies.

Somewhat prior to the study reported here, due to a host of factors, a newly found, generalized interest in the physiological and medical study of women had appeared. Among emphases of these studies were exercise and physical fitness, menstrual variations, and body composition. Quite specific questions were addressed elsewhere relative to the similarities of, or possible differences between, men and women in their responses to the environment of space. The first of a series of studies of specially selected women under simulated microgravity (bed rest) was conducted by investigators at the NASA Ames Research Center, Moffett Field, California, beginning in 1973 (39). Additional specific work was subsequently performed at the Ames Research Center, at the NASA Kennedy Space Center, and elsewhere, to refine the responses of women to orthostatic stressors (13,14,15,17,18,23,26,31,34,39,45). Some of these and other studies have measured responses of women to exercise with particular focus on probable responses to weightlessness (6,7,8,9,12,16,20,27,30,39,41,46,47). Meanwhile several American women astronauts have flown on Space Shuttle missions to give us both subjective and objective documentation of their resiliency to this new environment (40).

Nevertheless, this data set, not heretofore accessible in the public domain, is here reported because it represents one of the earliest space oriented (with emphasis on microgravity) data bases and is perhaps the largest such grouping using a common protocol. In addition, it yielded many biological

measurements of human responses to two major stressor protocols relevant to weightlessness--orthostasis (by erect standing in earth gravity and by lower body negative pressure) and ergometry (by motorized treadmill). Finally, it consisted of a diverse group of healthy women employees at the Johnson Space Center who were considered to be broadly representative not only of American women but also of future women astronauts (2) (age, life style, body habitus, physical condition, reproductive status, work and medical history, etc.).

METHODS

Subjects

Ninety-eight volunteer women subjects between the ages of 21-61 years were solicited from the work force of the Johnson Space Center. Review of their medical record, laboratory data, and an interim medical status questionnaire were used to assure absence of any clinical condition which would contraindicate their participation in either a lower body negative pressure (LBNP) or a treadmill exercise (TMX) stress test. Their use of replacement estrogen hormones, thyroid, oral contraceptives, or cigarettes was permitted. No prescreening of fitness level by stress testing was determined, but a three-scaled historical assessment of their usual activity level was obtained. None had previously participated in research studies in these laboratories.

Descriptive Historical and Clinical Data

Age, height and weight clothed but without shoes (recorded with calibrated clinical scales in English units, and later converted to metric), oral and room temperatures (using clinical and laboratory mercury in glass thermometers calibrated in Centigrade, with Fahrenheit values converted from a nomogram), and pulmonary functions were taken on the morning of, but prior to, each test. Body surface area was computed from the formula of Dubois (11). Hemoglobin, hematocrit, cholesterol, triglyceride, and clinical blood pressure values (within the past 12 months) were abstracted from their clinical records. Hours of sleep the previous night, hours since last eating, smoking and exercise history, current medications, and day of their current menstrual cycle with usual cycle length (or hysterectomy or postmenopausal state, if applicable) were recorded.

LBNP Stress Test

A graded LBNP stress test identical to that used on Apollo and Skylab crewmen was employed (22,24,25). Its protocol allowed five minutes of supine rest, fifteen minutes of incrementally reduced pressure applied below the level of the iliac crest (unless presyncope caused premature termination of the full protocol), and five minutes of recovery back at ambient pressure (see Figure L). Prior to initiation of each test, baseline

supine blood pressure, maximal calf circumferences (both), and volume of the left leg by the method of serial circumferences (22,24) were measured (See Figure V).

Appropriate non-invasive sensors provided heart rate from a Frank-lead orthogonal electrocardiogram; systolic and diastolic blood pressure from an automatically cycled arm cuff with microphone positioned over the left brachial artery to pick up Korotkov sounds; change in left and right calf volume (percentage change from control values) using a calibrated, double-stranded, mercury-in-silastic strain gauge; and systolic time intervals (STI) from the electrocardiogram, a phonocardiogram (20 gram Elema EMT-25C piezo-electric crystal accelerometer), and a carotid pulse trace (Sanborn/Hewlett Packard APT-16 displacement transducer). A pneumogram (thoracic mercury in silastic strain gauge) provided respiratory status to assure that all analyzed STI's were taken in the expiratory phase. At least 3 cardiac cycles, not necessarily consecutive, were used to determine the measurement for each state of condition. Reduction of STI data was performed with a Tektronix 4014 terminal using an interactive program of in-house design. All systems were functionally identical to those used on the Skylab LBNP studies (24).

For statistical analyses and reporting, dynamic data were used only from the resting and the highest attained level of LBNP (average of values, respectively, in the fifth minute of rest and in the fifth minute of -50 mm Hg phase of LBNP, except when presyncope intervened).

Treadmill Stress Test

Approximately 30 minutes after completion of the LBNP test, each subject underwent a graded treadmill exercise stress test similar to the Balke protocol using a speed of 3.3 mph and grade increments of 5 % with 3 minutes at each grade. Prior to each treadmill test, supine (after 5 minutes) followed by standing (after 8 minutes) heart rate and systolic and diastolic blood pressures were taken for comparison with the LBNP data. Dynamic heart rate, systolic and diastolic blood pressures, and oxygen consumption (with a CPI 5000 metabolic analyzer) were measured at the subject-limited, voluntary exertional effort (Quinton treadmill, model 1860) targeted for the maximal predicted heart rate. Time on the treadmill to that point was also recorded. Statistical analyses of these dynamic data were performed for the last minute of standing at rest, at the time of maximal effort, and for the second and the fifth minutes of recovery (supine). Signals for determining systolic time intervals (according to the same techniques used during LBNP) were taken in the supine position before initiation of the exercise protocol and as soon as possible (1-2 minutes) after maximal performance had been achieved.

Duplicate Tests for Reproducibility

After the primary data base had been established, identical protocols were conducted again on seventeen of these subjects who returned to the laboratory from two weeks to six months after their first testing. This provided a measure of reproducibility both from laboratory-team technique and from possible inherent changes over time. The inclusive dates for generation of data for this study were 13 October, 1976, through 26 April, 1977.

Statistical Analyses

Descriptive statistics were obtained for all numerical variables. These included mean, standard error of the mean, and minimal and maximal values. Pearson correlation coefficients were obtained for every pair of variables within the three grouped sets, and for selected pairs of variables between the sets. Variables which showed correlation significantly different from zero were further analyzed using simple linear regression models to assess the predictive capabilities for one set of variables toward the other. For test-retest comparisons the Student's t-test was used. All computations were performed with the SAS statistical package of SAS Institute, Inc., Cary, North Carolina, using a significance level of alpha = 0.05 for each test of hypothesis.

RESULTS AND DISCUSSION

Archival Data

Values of test variables for each individual subject are tabulated (Appendix) by grouping according to type: subject descriptors, ambient conditions, medical and historical information, clinical measurements, LBNP and TMX stress protocol responses, and certain anomalous events (Tables I through VIII). Subject numbers provide positive identification to allow any interrelationship of individual subjects and variables.

Parallel tabulations of data from those 17 subjects who underwent two sequences of tests are given in Tables IX through XV. Note that each subset is ordered identically so that each two corresponding lines of data derive from the same subject (i.e., subject number 22 = subject number 142, etc.). Direct comparisons may be seen by the computed means and standard errors of the mean from each test set.

Systolic time intervals were measured at supine rest and during maximal stress with the LBNP protocol and in the supine position before and after exercise with the TMX protocol. The pre-ejection period/left ventricular ejection time (PEP/LVET or just STI) ratios with their corresponding instantaneous heart rates are listed for the two protocols in Tables XVI and XVII, respectively.

Table XVIII provides calculated percentage changes for four major measures of stress (both LBNP and TMX) at their maximal response values using the respective resting value as reference: heart rate, systolic and diastolic blood pressures, and the systolic time interval ratios.

Table XIX gives double products (heart rate multiplied by systolic blood pressure) calculated whenever data permitted in the supine, resting position both before LBNP and before TMX, at maximal LBNP and during quiet standing (before TMX), as soon as possible after the TMX maximal effort, and at 2 and at 5 minutes after TMX (both supine).

Missing data occur in several tables. Omissions in any given table are due to either of three factors: data not generated, not available, or unreadable.

Statistical Data

Tables A1, B1, and C1 present for descriptive, LBNP test, and TMX test variables, the number of subjects contributing valid data for that variable, overall mean values, the standard errors of the means, and minimal and maximal values for each variable. For the most part, variables are presented in these tables in the same order of descriptive, LBNP, and TMX data sets given in the archival tables for individual subjects.

Tables A2, B2, and C2 present correlations (linear regressions), together with slopes and intercepts, between all pairs within the respective groups of variables in Tables A1, B1, and C1 which met statistical significance.

Tables D and E likewise present additional similar correlations, together with slopes and intercepts, between LBNP and TMX test variables, respectively, paired with other descriptive variables, and meeting the same statistical significance.

Table F shows statistically significant correlations between selected TMX and LBNP test variables paired as indicated.

Table G displays number of subjects contributing data, means, standard errors of the means, and minimum-maximum ranges for double products taken at several states of the two stress protocols.

Table NWA (courtesy of Edward C. Moseley, Ph. D., Johnson Space Center, Houston, Texas) is a recent (ca. 1987) compilation of several pertinent descriptive variables from current women astronauts resident at the Johnson Space Center. These data are provided primarily to allow comparisons between present women astronauts and similar variables of this data base, originally generated in anticipation of their selection.

The marked similarities between current women astronauts and subjects of this study group tested over a decade earlier is quite striking. This is evident from the considerable correspondence between mean values of variables given for these astronauts and those same variables (see Tables A1 and C1) of the rather heterogeneous group of women employees at the Johnson Space Center who were the subjects of this study. It is more remarkable since members of the study group were not so much selected as they were a volunteer sample of the women work force. That they so well represent, both physiologically and clinically, our present astronauts warrants use of this data base for comparisons with or projections to women exposed to the space environment.

Figures 1 through 6 show several statistically significant linear correlations among this subject group for pairs of variables reasonably expected to have shown such relationships (see also respective discussions below):

1. Heart rate at maximal treadmill exercise versus age
2. Peak oxygen uptake versus heart rate at maximal exercise
3. Peak oxygen uptake versus duration of exercise
4. Heart rates at maximal LBNP (-50 mm Hg) versus standing
5. Systolic blood pressures at maximal LBNP (-50 mm Hg) versus standing
6. Mean blood pressures at maximal LBNP (-50 mm Hg) versus standing.

The relatively large number of subjects contributing to these curves enhances the validity of their mathematical parameters.

Analytical Data and Findings

Repeatability of Test Measurements

Before attempting to understand the overall study results, an appreciation of the repeatability of test results under the circumstances of protocols used here is helpful (Tables IX through XV). This merges the inevitable variability of human subjects (a large component of this may be in the fact that no training or familiarization sessions preceded actual data taking tests), the inherent limits of hardware systems, certain variations or inconsistencies between different scientists and technicians who prepare and monitor subjects, and possible seasonal, training, and/or other factors which can introduce trend differences.

In general, descriptive and non-stressed data showed no change between the two mean values separated in time, even though individuals may have inexplicably large variations in measurements which can best be attributed to technique (e.g., height of subject 22 decreasing over 4 centimeters between her clinical measurement on 10 Dec 76 and that taken on her as subject 142 on 12 Apr 77; was it an error of converting to metric units; did she wear shoes, etc.?). Mean room

temperatures also did not differ significantly, but values for the winter months when internal heating prevailed tended to exceed those with more moderate outside weather.

Unfortunately, duplicate clinical blood/chemistry data were not often available and pulmonary function data were not repeated.

All mean heart rate and blood pressure values for the first LBNP test were higher than those of the second test. These, however, were statistically significant only for diastolic pressure readings and for the supine resting systolic values from the LBNP protocol. This may well be attributed to the general anxiety attendant a new, unknown experience encountered for the first time. None of the leg dimensional mean values differed between the two tests.

Like that for the LBNP protocol, supine resting systolic blood pressure taken at the first TMX test was significantly greater than that of the second test. Other blood pressure values between the two TMX tests showed no differences, probably due to the overriding effect of the metabolic stimulus of exercise which obscures a lesser effect of anxiety. On the other hand, several mean values from the TMX tests were greater for the second test; heart rate at the second minute of recovery from treadmill exercise, maximally achieved oxygen consumption and duration on the treadmill were significantly elevated. These may be attributed to gains from familiarization effects of the first test, both for the subjects as well as for the laboratory test team, resulting in a greater maximal volitional effort for the second test.

Specific Determinations

The descriptive information shown in Tables I, II, IX, X, and A1 fully supports the assertion that the subjects of this study were normal, healthy, and reasonably representative of middle-aged active women (7,8,12,14,15,17,27,39,43,46,47). Of the 71 who were regularly menstruating, 31 (44%) were using oral contraceptives. One on oral contraceptives had highly irregular menstrual periods. Of the remaining 26, nine (35%) had begun or completed menopause and 17 (65%) had had hysterectomies.

At the outset of this study a concern had been voiced that women may evidence dissimilar orthostatic responses at different times in their menstrual cycle. This concern was supported by clinical alterations, both subjective and physiological, which might predispose to alter orthostatic intolerance. Mechanistically, with greatest fluid retention occurring premenstrually (38,42,44), maximal orthostatic tolerance would be predicted at this phase.

Thus, even though the design of this study was cross-sectional, it was reasoned that a large number of women tested at random in their menstrual cycles would reveal such a relationship if it

existed. A potential confounding of this thesis was the large number of regularly menstruating women using oral contraceptives (42).

In any case, no specific correlations of LBNP or TMX responses to phase of menstrual cycle (determined as the ratio of cycle day to cycle length for the time axis) were determined. Several studies since that time have demonstrated no differential responses of the cardiovascular system which would suggest functional or performance deficits due to phase of menstrual cycle (9,12,13,16,17,20,30,39,41,43). On the other hand, it is more likely that high levels of regular physical activity may affect and even disrupt the normal menstrual pattern (3,4,36).

Many of the statistical correlations in Table A2 are expected because of the interaction of the paired variables, but some more likely have physiological meaning: the known relationships of age, and the direct correspondence of height and weight with pulmonary function (especially vital capacity); the inverse associations of body surface area with triglycerides and of menstrual cycle length with diastolic blood pressure; and the direct relations between age and cholesterol (well described in medical literature), cholesterol and triglycerides, systolic blood pressure and triglycerides, and body surface area and clinical blood pressures. Some of these no doubt are related mechanistically, but others must await further knowledge for a rational explanation or may prove to be only coincidental random statistical artifacts.

Certain mean values from Tables B1, C1, and G warrant attention. The correspondence among orthostatic stressors usually depends upon the variable in question (32,33,49). As used with American space crews, LBNP at -50 mm Hg has most closely evoked heart rate elevations comparable to those observed in quiet standing when referenced to those in the supine position (22). These two independently applied stressors in this study have corroborated this contention for heart rates, 74 to 88 beats per minute for LBNP and 73 to 88 beats per minute for quiet standing. This degree of equivalence from 98 women subjects is truly remarkable.

Graphical presentation of these data (Figure 4) further clarifies this relationship. The slope is less than unity, although identical heart rates occurred at the mean values for both orthostatic stressors (during -50 mm Hg LBNP and during quiet standing). Therefore, subjects who exhibited intrinsically lower heart rates showed greater LBNP responses than for standing; the converse was obtained for those with higher heart rates. Hence, different responses to these two stressors seem to be related to inherent or basal heart rate. Thus, individuals with lower heart rates, likely manifesting a relative dominance of parasympathetic control, seem more sensitive to LBNP, while those with higher heart rates, presumably indicative of relative sympathetic dominance, appear more sensitive to gravitational

stress. An alternate way of stating this relationship is that the gain in heart rate for the gravitational gradient is greater than for LBNP.

Mean systolic blood pressure decreased from supine rest to maximal LBNP (104 to 95 mm Hg) while it increased from supine rest upon upright standing in one gravity (104 to 111 mm Hg). The corresponding diastolic values for LBNP were unchanged (67 mm Hg) but for gravity were elevated (67 to 74 mm Hg). This also resulted in differential orthostatic stressor responses for the mean blood pressure: LBNP (slightly reduced from 79 to 76 mm Hg) and gravity (increased from 79 to 86 mm Hg). (See Figure 6). The disparity between blood pressure responses for these two stressors has previously been noted (22). Its explanation is still elusive, but likely originates in differential stimulations of baroreceptors as well as varied regional distributions of vascular volume (19). These qualitatively different pressure responses to two orthostatic stressors likely contribute to the similarity in the above described heart rate differentials and probably in part account for alleged excessive and sometimes adversely interpreted responses among more physically or aerobically fit individuals (See Tables B1 and C1 and Figure 5).

It may well be reasoned that the body would not respond with all its control systems identically to the stress of LBNP (a discretely applied differential pressure at the iliac crest) and to the stress of the gravitational vector (a smooth gradient from foot to head). Indeed, that the heart rate or any other variable (e. g., change in leg volume) should be so similar for the two orthostatic conditions is perhaps fortuitous. The similarity of such responses must result from integrative control mechanisms which have thereby provided a predictive tool in LBNP for testing human orthostatic tolerance in the absence of gravity.

The two other major components of cardiovascular dynamics, viz., blood flow and total peripheral resistance, were both unmeasured here. Cardiac output is known to fall in both situations, however, while peripheral resistance can be quite variable depending upon the vascular region studied (13,14,15,19).

Supine resting heart rate was inversely correlated with change in right leg volume, but directly and very highly with maximal heart rate attained during LBNP. Both systolic and diastolic (resting supine and maximal during LBNP) blood pressures were directly correlated with maximal calf circumferences and left leg volume. These findings (Table B2) likely have multiple explanations, with contributions from both acute control mechanisms of the cardiovascular system and from more long term controls of fluid volumes. With relative sympathetic dominance (which would be expected to manifest in higher supine resting heart rate and higher blood pressures), a lesser increase in leg volume during LBNP might suggest increased (neural or endocrine) peripheral vascular tone. It could as well represent increased intravascular, or extracellular in general, volume. In reality, no single factor is likely the sole explanation for these

findings. The association of greater blood pressure values with larger leg size is consistent with a diminished peripheral compliance reflected within the vascular system. This also could have contributions both from elements which determine vascular wall tone and from factors controlling vascular volume.

Yet other measurements whose response is conditioned by several interdependent factors are the systolic time intervals. The most meaningful single measurement from these determinations is probably the pre-ejection period/left ventricular ejection time ratio (PEP/LVET or STI ratio); it also removes heart rate dependency. The PEP is increased while the LVET is decreased by diminished preload; both are decreased by positive inotropic effects. Again the supine resting ratios are quite comparable from both the LBNP and the TMX protocols (another form of repeated measures), 0.292 and 0.283, respectively. Their values in response to the stressors, however, differ considerably; that during maximal LBNP increased to 0.419 while that immediately following maximal TMX effort hardly increased, 0.306. Of course, the hyperdynamic state induced by exercise contributes to cardiac contraction an enhanced inotropic factor as well as cardioacceleration. No doubt there is also considerably greater cardiac return during exercise as compared to that during LBNP, when cardiac return is greatly reduced. This results in decreased preload which is reflected in elevated PEP/LVET ratio (well correlated with the left ventricular ejection fraction) during LBNP (28).

A similarly conditioned variable is the double product. This measurement closely estimates the myocardial oxygen requirement (21). Table G shows again the good repeatability of supine resting mean values from both stressor protocols. However, the corresponding values for the respective stressed states differ notably; that for LBNP increased only 9 percent while that for TMX increased 28 percent. The active mechanism here is probably similar to that proposed above with respect to systolic time intervals. It is evident that this value for exercise is about three times greater than that evoked by orthostasis (LBNP or gravity).

Fully expected and here substantiated were the high direct correlation of maximally achieved TMX heart rate with oxygen consumption (Table C2) and the inverse correlation of that heart rate with age (Table E). An additional interrelated correlate was the duration of exercise, which agreed well with both maximal heart rate and peak oxygen consumption (Table C2).

Figures 1, 2, and 3 present these relationships graphically. In this well known age relationship (1), the women of this study wrote the nomogram for volitional maximal exercise heart rate equal to 207 - .78 x age. The relationship of oxygen uptake and heart rate is also described as the oxygen pulse. Here the gain is approximately one-fourth milliliter oxygen per kilogram body

weight per heart beat per minute. Augmentation of oxygen uptake with longer times of exercise reflects the greater metabolic load sustained by these more fit subjects.

Tables D and E list other variables from the total data set which correlated significantly with specific measurements generated during the two stressor protocols. Also expected and observed were the direct correlations of diastolic blood pressure with age and of the peak oxygen consumption with habitual level of exercise reported, and the inverse correlation of peak oxygen consumption with age.

CONCLUSIONS

This study has produced a large physiological data base generated from women representative in many attributes of current women astronauts. It has provided historical and clinical descriptive values for the population subset and their characteristic responses to two forms of orthostatic stress (lower body negative pressure and standing in one gravity) and to treadmill exercise stress, all of particular interest in the study of human responses to exposure to microgravity.

Results from this study warrant comparison with similar data from women astronauts who fly into space. These results may also serve as a useful reference for other ground based studies of women subjects which may use more advanced techniques and produce measurements not made in this study. The presentation of data in archival form allows subsequent evaluations not here entertained.

Findings determined from the present analyses, however, suggest that women will exhibit responses to microgravity little if any different from those of men, who were the focus of most earlier studies performed. Further, a hypothesized differential response of women to orthostatic stressors dependent upon the phase of their menstrual cycle was not substantiated.

APPENDIX

DATA TABLES AND FIGURES

The following tables contain data sets from all 98 subjects:

The following tables contain data sets from 17 subjects who underwent repeat tests (note that the same subject holds the same position in each subset; i.e., subject 22=142, subject 1=143,etc.):

The following tables contain data sets from all 98 subjects:

The following tables contain statistical data derived from selected individual sets above:

A1	Summary Statistics of Descriptive Variables
A2	Significant Correlations between Descriptive Variables (p<0.05)
B1	Summary Statistics of LBNP Test Variables
B2	Significant Correlations between LBNP Test Variables (p<0.05)
C1	Summary Statistics of Treadmill Test Variables
C2	Significant Correlations between Treadmill Test Variables
D	Significant Correlations between LBNP Test Variables and Selected Descriptive Variables
E	Significant Correlations between Treadmill Test Variables and Selected Descriptive Variables
F	Selected Significant Correlations between Treadmill and LBNP Test Variables
G	Summary Statistics of Double Products

These data were furnished from the Johnson Space Center, Houston, Texas, and presented in tabular form:

NWA	Selected Descriptive Statistics of NASA Women Astronauts

The following figures depict aspects of protocols used in this study:

L The LBNP protocol used in this study was the same as that used in the Skylab experiment

V The method of multiple leg circumferences used to measure leg volumes in this study

The following figures provide graphical display of selected known relationships as they pertain to this particular subject group:

1 Linear Correlation of Maximal Heart Rate Attained during Treadmill Exercise versus Age

2 Linear Correlation of Peak Oxygen Uptake versus Maximal Heart Rate Attained during Treadmill Exercise

3 Linear Correlation of Peak Oxygen Uptake versus Duration of Treadmill Exercise

4 Linear Correlation of Maximal Heart Rate Attained during LBNP versus during Standing

5 Linear Correlation of Systolic Blood Pressure at Maximal LBNP versus Standing Systolic Blood Pressure

6 Linear Correlation of Mean Blood Pressure at Maximal LBNP versus Standing Mean Blood Pressure

KEY TO ABBREVIATIONS FOR VARIABLES NAMED IN THE TABLES

DISCRETE VARIABLES

SUBJ = subject number
T-oral = oral temperature (deg F)
T-room = room temperature (deg F)
BSA = body surface area (sq m)
MENSTRUAL HISTORY = cycle day/cycle length (days); if none, PM = post-menopausal or HY = hysterectomy, followed by the number of years prior to testing for this event
LIFESTYLE: smoke, 1=yes, 2=no; exercise, 1=inactive, 2=moderately active, 3=very active
SLEEP TIME = hours of sleep during previous night
EAT TIME = hours since subject last ate
HGB = hemoglobin (gm %)
HCRT = hematocrit (%)
T-CHOL = total serum cholesterol (mg %)
TRIG = serum triglycerides (mg %)
FEV-1 = forced expiratory volume (L) in 1 second
FVC = forced vital capacity (L)
FOF = FEV-1/FVC x 100 (%)
VC = vital capacity (L)

LBNP VARIABLES

HR-SUP = heart rate (bpm) following 5 min. supine, pre-LBNP
HR-MAX = heart rate (bpm) at maximal LBNP
S-CLIN = systolic blood pressure (mm Hg), sitting, from clinical records
D-CLIN = diastolic blood pressure (mm Hg), sitting, from clinical records
S-SUP = systolic blood pressure (mm Hg) after 5 min. supine rest
D-SUP = diastolic blood pressure (mm Hg) after 5 min. supine rest
S-MAX = systolic blood pressure (mm Hg) at -50 mm Hg (or maximal attained) LBNP
D-MAX = diastolic blood pressure (mm Hg) at -50 mm Hg (or maximal attained) LBNP
LCC = left calf circumference (cm) after 5 min supine
RCC = right calf circumference (cm) after 5 min supine
CHANGE LLV = % change in left leg volume from 0 to -50 mm Hg (or maximal attained) LBNP
CHANGE RLV = % change in right leg volume from 0 to -50 mm Hg (or maximal attained) LBNP
LLV = left leg volume (ml) at supine rest

TREADMILL VARIABLES

HR-SUP = heart rate (bpm) after 5 min. supine rest, pre-test
HR-STN = heart rate (bpm) after 8 min. quiet standing, pre-test
HR-HYV = heart rate (bpm) after 20 sec. hyperventilation
HR-MAX = maximal heart rate (bpm) during treadmill test
HR-R2 = heart rate (bpm) at 2 min. recovery
HR-R5 = heart rate (bpm) at 5 min. recovery
V-O2 = peak oxygen uptake (ml/kg/min) during treadmill test
DUR EXER = duration of exercise (min) on treadmill
S-SUP = systolic blood pressure (mm Hg) after 5 min. supine rest, pre-test
D-SUP = diastolic blood pressure (mm Hg) after 5 min. supine rest, pre-test
S-STN = systolic blood pressure (mm Hg) after 8 min. quiet standing, pre-test
D-STN = diastolic blood pressure (mm Hg) after 8 min. quiet standing, pre-test
S-MAX = systolic blood pressure (mm Hg) nearest maximal level of treadmill test
D-MAX = diastolic blood pressure (mm Hg) nearest maximal level of treadmill test
S-R2 = systolic blood pressure (mm Hg) at 2 min. recovery
D-R2 = diastolic blood pressure (mm Hg) at 2 min. recovery
S-R5 = systolic blood pressure (mm Hg) at 5 min. recovery
D-R5 = diastolic blood pressure (mm Hg) at 5 min. recovery

ARRHYTHMIAS

PAC = premature atrial contraction
PVC = premature ventricular contraction

SYSTOLIC TIME INTERVALS (STI) DATA

PEP/LVET (also STI) RATIO = pre-ejection period/left ventricular ejection time
HR-INST = heart rate (bpm), instantaneous, from the complex used for measuring STI

DOUBLE PRODUCT DATA

DPSUNP = supine, at rest prior to LBNP test
DPSUTM = supine, at rest prior to TMX test
DPLBNP = at maximal level of LBNP attained
DPSTN = standing, at rest prior to TMX test
DPTMX = at maximal level of TMX exercise
DP2 = at 2 minutes after maximal level of TMX exercise
DP5 = at 5 minutes after maximal level of TMX exercise

TABLE I SUBJECT AND TEST DESCRIPTIVE DATA

SUBJ	TEST DATE	AGE years	HEIGHT cm	WEIGHT kg	T-oral deg F	T-room deg F	BSA sq m
1	13Oct76	25	163.0	46.7	98.2	74.0	1.48
4	8Nov76	25	163.0	55.8	98.6	71.0	1.60
5	12Nov76	48	172.0	62.6	98.0	70.0	1.77
6	19Nov76	24	163.0	48.5	98.0	73.0	1.50
7	22Nov76	36	166.0	61.7	98.2	71.0	1.69
8	23Nov76	22	156.0	46.3	98.2	71.0	1.45
9	24Nov76	35	163.0	59.0	98.4	72.0	1.64
15	2Dec76	24	165.0	56.2	98.4		1.63
16	3Dec76	36	163.0	57.2	98.2	74.0	1.62
18	6Dec76	24	158.0	47.6	98.2	75.0	1.46
19	7Dec76	35	163.0	49.9	98.0	74.0	1.53
20	8Dec76	45	173.0	59.0	98.2	74.0	1.73
21	9Dec76	22	158.0	74.8	98.4	75.0	1.81
23	13Dec76	37	165.0	54.4	98.2	67.0	1.62
24	14Dec76	23	165.0	54.0	97.8	73.0	1.58
25	15Dec76	27	158.0	46.3	97.8	73.0	1.41
26	16Dec76	27	155.0	61.2	98.4	75.0	1.60
27	17Dec76	61	158.0	49.9	98.4	74.0	1.50
28	20Dec76	28	164.0	68.0	98.0	75.0	1.77
29	21Dec76	24	160.0	45.4	97.6	71.0	1.47
31	4Jan77	22	168.0	60.0	98.2	72.0	1.69
32	4Jan77	26	165.0	64.5	99.4	73.0	1.73
33	5Jan77	37	159.0	53.6	98.0	74.0	1.53
34	6Jan77	32	168.0	53.5	98.0	73.0	1.57
35	7Jan77	51	161.0	63.3	98.0	72.0	1.84
36	10Jan77	40	164.0	62.2	98.0	72.0	1.67
38	11Jan77	34	150.0	51.7	98.4	75.0	1.45
41	12Jan77	21	160.0	49.2	98.6	73.0	1.49
43	13Jan77	24	158.0	47.2	99.6	73.0	1.45
48	14Jan77	23	167.0	57.3	98.4	74.0	1.64
49	17Jan77	46	170.0	67.3	98.0	74.0	1.78
50	18Jan77	30	168.0	55.5	98.0	72.0	1.61
51	19Jan77	29	165.0	54.4	97.8	73.0	1.59
52	20Jan77	32	169.0	76.5	97.8	74.0	1.81
53	21Jan77	24	169.0	60.0	98.4	75.0	1.80
54	24Jan77	31	168.0	61.2	98.2	72.0	1.69
56	25Jan77	52	175.0	71.7	98.6	75.0	1.87
57	26Jan77	42	170.7	53.8	98.0	74.0	1.62
58	27Jan77	25	170.2	65.3	98.2	76.0	1.75
59	28Jan77	44	167.0	57.9	97.8	74.0	1.65
60	31Jan77	46	157.4	76.4	97.8	67.0	1.78
61	1Feb77	58	158.7	59.1	97.8	69.0	1.60
62	2Feb77	31	169.0	56.0	98.4		1.64
63	3Feb77	23	170.7	62.3	98.0	72.0	1.73
64	3Feb77	24	172.7	59.4	98.6	73.0	1.78
65	4Feb77	55	170.2	66.2	98.0	71.0	1.77
66	4Feb77	29	166.0	68.0	98.6	73.0	1.76
67	7Feb77	55	166.2	68.4	98.0	71.0	1.76
68	7Feb77	34	164.4	65.1	98.0	74.0	1.71

TABLE I SUBJECT AND TEST DESCRIPTIVE DATA

SUBJ	TEST DATE	AGE years	HEIGHT cm	WEIGHT kg	T-oral deg F	T-room deg F	BSA sq m
69	8Feb77	52	180.0	61.9	97.8	73.0	1.79
70	9Feb77	36	165.0	57.6	98.2	72.0	1.63
72	10Feb77	26	159.0	70.4	97.8	72.0	1.73
73	11Feb77	32	162.3	63.2	97.8	73.0	1.68
74	14Feb77	23	174.8	66.3	98.0	72.0	1.80
75	15Feb77	38	173.2	67.4	98.6	70.0	1.81
76	15Feb77	43	161.3	61.9	98.0	73.0	1.65
77	16Feb77	31	162.3	52.4	98.0	69.0	1.55
78	16Feb77	29	162.2	53.3	98.0	73.0	1.56
80	18Feb77	29	161.2	60.6	98.0	71.0	1.64
81	18Feb77	30	163.6	63.3	98.2	73.0	1.69
83	22Feb77	46	166.8	71.8	98.0	72.0	1.80
84	22Feb77	41	166.3	60.6	98.2	73.0	1.68
85	23Feb77	47	165.3	59.2	98.4	72.0	1.65
86	24Feb77	25	167.1	56.7	97.8	71.0	1.63
87	24Feb77	26	165.5	63.7	98.6	73.0	1.71
88	25Feb77	31	172.5	67.1	98.0	72.0	1.80
90	28Feb77	42	165.0	49.1	97.8	71.0	1.52
91	28Feb77	30	159.0	53.6	97.6	73.0	1.54
92	1Mar77	41	163.4	53.4	97.8	72.0	1.57
93	1Mar77	21	167.7	53.6	97.8	75.0	1.60
94	2Mar77	52	155.0	54.2	97.6	73.0	1.52
96	3Mar77	20	162.1	47.6	98.0	74.0	1.48
97	3Mar77	37	168.8	61.2	98.4	75.0	1.70
98	4Mar77	32	170.6	54.8	97.8	70.0	1.64
100	8Mar77	50	164.9	50.3	97.8	72.0	1.54
101	9Mar77	34	160.3	62.7	97.8	71.0	1.65
102	9Mar77	31	169.6	71.4	98.0	73.0	1.82
107	15Mar77	33	163.6	52.6	97.8	71.0	1.56
108	15Mar77	26	154.2	48.7	97.8	74.0	1.45
109	16Mar77	47	164.7	54.9	98.2	72.0	1.60
110	16Mar77	29	167.2	53.5	98.0	73.0	1.60
111	17Mar77	42	176.8	68.5	98.4	71.0	1.84
112	18Mar77	38	167.3	73.1	98.2	72.0	1.82
113	18Mar77	44	172.5	63.8	97.8	78.0	1.76
115	22Mar77	39	157.5	59.5	97.9	72.0	1.60
116	23Mar77	23	160.0	71.0	98.6	71.0	1.74
117	24Mar77	34	165.1	84.3	98.2	72.0	1.92
118	29Mar77	25	170.0	80.3	98.2	72.5	1.92
123	30Mar77	30	170.0	75.5	97.8	72.5	1.87
124	30Mar77	25	155.8	66.2	98.4	74.0	1.66
127	30Mar77	25	155.0	55.3	98.8	75.5	1.53
144	14Apr77	57	165.0	58.1	97.8	71.5	1.64
146	15Apr77	47	166.5	57.1	97.8	70.0	1.63
147	15Apr77	39	170.2	75.5	97.8	72.0	1.87
153	21Apr77	37	166.0	60.6	97.4	72.5	1.67
155	22Apr77	40	166.0	67.3	98.6	70.0	1.75
156	25Apr77	26	163.0	51.6	97.8	72.0	1.54
158	26Apr77	29	165.0	61.0	97.4	73.0	1.67

TABLE II SUBJECT AND TEST HISTORICAL DATA

SUBJ	MENSTRUAL HISTORY		MEDICATIONS	LIFE STYLE		SLEEP/EAT TIME	
	Cycle day/length/none			smoke	exer	Hours	Hours
1	25	28				8.5	12.0
4	6	28	oral contrac	2	1	5.0	12.0
5			PM-2	1	3	5.5	2.0
6	11	28		2	2	7.0	11.5
7			HY-2 estrogen	1	1	6.5	14.0
8	14	28		2	2	6.5	13.0
9	21	30		1	3	8.5	14.0
15	16	30		2	1	7.0	14.0
16	5	30		1	1	8.0	12.0
18	7	28	oral contrac	2	2	7.0	12.0
19	12	30		2	1	11.0	1.5
20			PM-1.5	2	1	6.0	16.0
21	30	31		1		6.5	10.5
23	14	30		1	2	5.5	2.0
24	11	30		2	2	6.0	12.0
25	18	30		2	1	7.5	14.0
26	14	30		2		9.0	14.0
27			PM-5	1	1	7.0	1.5
28	14	30		1	2	6.0	12.5
29	14	30	oral contrac	2	1	8.0	13.0
31	10	21		2	1	6.0	15.0
32	11	30	oral contrac	2		7.0	14.0
33	14	30		1	2	7.0	5.0
34	33	35		1	2	7.0	10.0
35			PM-10	1	2	7.5	13.0
36	28	30		1	2	6.5	16.0
38			HY-6	1	2	8.0	12.0
41	4	30	oral contrac	1	2	9.0	13.5
43	5	28	oral contrac	2	3	5.5	1.5
48	27	28	oral contrac	1	1	7.0	12.0
49			HY-5.5	2	1	6.5	12.0
50	21	28	oral contrac	2	1	7.0	15.0
51	7	30		2	2	6.0	2.0
52			HY-0.3	2	2	8.0	14.0
53	90	?	oral contrac	1	2	5.0	9.5
54	20	28	oral contrac	1	2	7.5	12.5
56			PM-7	1	1	8.0	12.0
57	19	31		1	2	6.0	13.0
58	4	28	oral contrac	1	2	7.5	15.0
59	18	31		2	1	7.0	2.5
60	12	28		1	2	5.0	12.5
61			HY-17 estrogen	1	2	6.5	2.0
62	14	31	oral contrac	1	3	7.5	2.3
63	21	28	oral contrac	2	2	8.0	13.0
64	14	28	oral contrac	2	1	6.0	11.0
65	4	28	estrogen	2	3	8.0	12.5
66	1	28	oral contrac	2	2	8.0	15.0
67			PM-3	2	3	8.0	2.5
68	7	28		1	2	7.0	11.0

TABLE II SUBJECT AND TEST HISTORICAL DATA

SUBJ	MENSTRUAL HISTORY Cycle day	length	none	MEDICATIONS	LIFE STYLE smoke	exer	SLEEP/EAT TIME Hours	Hours
69			HY-9	estrogen	1	2	6.0	7.0
70	13	28			1	2	6.0	2.0
72	14	28		oral contrac	2	2	8.0	18.0
73	7	25			2	1	8.0	14.0
74	10	28		oral contrac	1	2	12.0	12.0
75	23	26			2	2	7.0	1.0
76	9	28			1	3	7.0	2.0
77	14	28		thyroid	1	2	6.0	13.0
78	3	28			2	1	7.0	21.0
80	25	28		oral contrac	2	2	8.0	13.5
81	16	28		oral contrac	2	1	8.0	11.0
83			HY-7	estrogen	2		7.0	11.0
84	19	28			2	3	7.5	2.5
85			HY-16	estrogen	2	2	6.5	3.0
86	3	28		oral contrac	2	3	8.5	12.5
87	7	28			1	2	7.5	15.0
88	21	28			2	2	8.0	13.5
90			HY-12	estrogen	1		6.0	2.0
91	14	28		oral contrac	1	2	11.0	19.0
92			HY-3		2		8.0	14.5
93	14	28		oral contrac	2	3	8.0	14.0
94			PM-5	estrogen	1	1	7.0	2.5
96	11	21		oral contrac	2	1	7.0	14.0
97			HY-7	thyroid	2	1	7.0	3.5
98	12	28		oral contrac	2	3	7.5	12.5
100			HY-2	estrogen	2	2	6.0	2.5
101			HY-2	estrogen	1	2	6.5	13.0
102			HY-0.5	estrogen	1	3	6.5	14.0
107	14	32			1	2	6.0	11.0
108	15	32			2	1	5.5	15.5
109			PM-0.2		1	1	6.0	14.0
110	16	28		oral contrac	1	2	8.0	14.5
111			HY-?	thyroid	2	1	6.5	12.0
112	11	28			2	1	6.0	2.5
113			HY-5	estrogen	2	1	7.5	14.5
115	8	28		oral contrac	1	1	8.0	14.0
116	14	28		oral contrac	2	2	8.5	14.0
117	7	28			2	1	9.0	12.0
118	5	28			2	3	8.0	1.0
123	24	28		OC, thyroid	1	2	8.0	1.0
124	24	28		oral contrac	2	2	8.0	1.0
127	15	28		oral contrac	2	2	8.0	19.0
144			PM-?		2	2	6.5	11.0
146			HY-3	estrogen	1	2	7.0	11.0
147	14	29			1		6.0	11.0
153	12	28		oral contrac	2	2	7.5	12.0
155	23	28			2		7.5	2.0
156	10	40			1	3	7.0	13.5
158	22	29			1	2	7.5	3.0

TABLE III BLOOD AND PULMONARY TEST DATA

SUBJ	HGB gm %	HCRT %	T-CHOL mg %	TRIG mg %	FEV-1 L	FVC L	FOF %	VC L
1	13.1	39	175	116	3.10	3.61	85	3.39
4	15.4	46	182	113	3.18	3.25	97	2.92
5	13.7	41	256	117				
6	14.0	41	247	59	3.08	3.52	87	3.55
7	14.0	44	181	63	2.59	2.98	86	2.65
8	13.3	40	185	56	3.37	3.84	87	2.96
9	13.4	40	149	63	3.25	3.88	83	3.67
15	12.5	40	215	78	3.25	3.65	89	3.67
16	12.9	39	267	86				
18	11.9	38	180	87	2.04	2.35	86	3.39
19	12.1	38	227	43				
20	10.1	32	175	52	3.57	3.88	92	3.78
21	12.9	39	147	108	2.16	2.63	82	2.53
23	13.1	40	149	65	2.86	3.25	88	2.89
24	13.2	40	163	51	3.76	4.08	92	3.78
25	12.3	38	226	61	2.55	2.70	94	2.69
26	12.4	38	160	44	2.74	3.10	88	3.00
27	13.4	41	150	100				
28	13.8	41	165	95	2.86	3.37	84	3.20
29	14.3	44	267	107	3.33	3.68	90	3.55
31	14.3	43	117	48	3.72	4.59	81	4.33
32	11.6	36	260	107	3.45	4.16	82	4.02
33	13.7	41	239	93	2.63	3.33	78	3.43
34	15.0	44	167	54	3.57	4.19	85	3.90
35	13.0	40	187	80	2.63	3.41	77	3.28
36	12.2	39	268	107	3.06	3.88	78	3.90
38	13.3	42	185	45	2.55	2.98	85	2.81
41	12.4	37	153	86	2.63	3.53	74	3.59
43	12.2	37	229	71	3.61	3.72	97	3.59
48	13.0	40	231	104	3.25	3.88	83	3.28
49	14.1	43	288	117	2.35	3.14	74	4.25
50	13.9	42	218	105	3.49	3.61	96	3.43
51	13.5	39	164	70	2.74	3.10	88	3.08
52	13.8	42	203	128	3.80	5.25	72	5.15
53	12.8	39	240	115	3.06	3.41	89	3.67
54	13.8	43	193	96	3.06	3.68	83	4.06
56	12.9	40	228	53	2.59	5.10	50	5.31
57	13.2	40	232	70	3.33	4.47	74	4.45
58	12.8	40	206	136	3.18	3.72	85	3.47
59	12.7	38	191	52	3.02	4.04	74	3.78
60	12.2	38	199	105	2.27	2.98	76	2.81
61	12.3	39	185	173	1.80	2.63	68	2.38
62	13.5	40	177	82	3.21	3.61	88	3.32
63	10.7	34	174	81	3.10	4.16	74	4.06
64	12.2	38	188	69	2.51	2.78	90	3.59
65	11.9	35	232	89	3.21	3.45	93	3.39
66	13.5	42	217	81	2.98	3.88	76	3.47
67	13.1	40	297	79	2.90	3.76	77	3.59
68	12.8	39	223	43	2.04	2.39	85	3.35

TABLE III BLOOD AND PULMONARY TEST DATA

SUBJ	HGB gm %	HCRT %	T-CHOL mg %	TRIG mg %	FEV-1 L	FVC L	FOF %	VC L
69	13.9	42	258	119	2.98	4.23	70	3.86
70	12.6	40	199	62	3.41	4.00	85	3.98
72	10.8	35	204	122	2.67	3.02	88	2.38
73	13.6	43	226	160	3.49	3.72	93	3.59
74	11.5	36	195	70	3.37	3.80	88	3.55
75	13.6	41	154	65	3.76	4.55	82	4.53
76	12.0	38	210	37	2.82	3.76	75	3.59
77	15.3	45	197	63	3.57	3.88	92	3.78
78	13.5	42	238	50	2.70	3.21	84	3.12
80	12.5	39	289	140	3.33	3.68	90	3.75
81	12.3	28	170	103	3.25	3.68	88	3.63
83	13.1	40	220	139	2.94	3.49	84	3.51
84	11.6	34	159	68	3.33	3.72	89	3.59
85	11.4	36	290	68	2.70	3.37	80	3.20
86	13.4	40	188	126	2.90	3.80	76	3.63
87	13.8	42	147	45	3.41	4.35	78	4.33
88	15.2	44	181	89				
90	13.2	41	289	39	2.20	2.94	74	2.73
91	13.2	40	277	91	2.74	3.45	79	3.28
92	12.7	40	203	80	2.27	2.82	80	2.77
93	14.2	44	192	54	3.53	4.04	87	3.82
94	13.8	42	254	198	1.96	2.55	76	2.46
96	13.4	40	184	67	3.21	3.92	81	3.43
97	14.5	45	242	65	2.98	4.00	74	3.82
98	14.3	44	248	83	4.16	4.39	94	4.41
100	14.1	42	244	97	2.74	3.57	76	3.39
101	13.2	40	224	58	3.41	4.59	74	4.06
102	10.5	33	145	75	3.21	4.19	76	4.06
107	13.0	39	223	64	2.63	3.45	76	3.32
108	11.9	36	199	42	2.74	2.94	93	2.73
109	12.7	40	288	77	2.90	3.88	74	3.67
110	11.7	37	166	85	3.72	3.92	94	3.71
111	14.2	44	178	57	3.80	4.66	81	4.45
112	11.9	36	179	160	3.41	3.70	90	3.20
113	12.3	38	207	86	3.76	4.70	80	4.57
115	12.6	38	288	184	2.94	3.61	81	3.47
116	13.1	40	158	97	3.25	4.12	78	4.02
117	14.1	43	234	106	3.57	4.16	85	4.02
118	13.3	40	245	141	4.08	4.47	91	4.33
123	13.3	42	261	167	3.25	3.88	83	3.67
124	13.5	42	207	92	2.98	3.53	84	3.28
127	13.5	42	169	126	2.86	3.49	81	3.35
144	13.2	41	214	144	2.16	3.37	64	3.43
146	11.9	37	179	108	2.78	3.37	82	3.28
147	12.9	39	252	73	3.41	4.23	80	3.98
153	13.4	40	180	77	3.18	3.88	81	3.67
155	12.8	39	223	72	3.02	4.12	73	3.86
156	12.0	37	160	39	3.53	4.00	88	3.78
158	12.8	40	212	89	3.37	4.12	81	3.82

TABLE IV LBNP TEST HEART RATE AND BLOOD PRESSURE DATA

SUBJ	HR-SUP bpm	HR-MAX bpm	S-CLIN mm Hg	D-CLIN mm Hg	S-SUP mm Hg	D-SUP mm Hg	S-MAX mm Hg	D-MAX mm Hg
1	77	86	103	66	99	62	97	63
4	86	106			116	86	106	84
5	71	79	103	58	89	58	93	63
6	90	103	108	60	104	58	111	71
7	76	85	135	68	126	88	111	84
8	80	105	111	67	107	77	95	66
9	73	88	106	60	100	68	100	71
15	69	93	94	65	86	61	77	61
16	70	86	90	70	87	60	103	73
18	78	112	102	52	91	52	80	51
19	93	112	110	70	104	72	98	74
20	54	61	99	72	97	72	96	73
21	70	88	104	74	108	73	101	73
23	63	70	98	60	95	66	95	70
24	78	82	102	62	96	56	72	54
25	95	105	110	70	109	55	103	57
26	74	89	101	81	98	77	95	71
27	85	96	95	60	99	65	97	68
28	73	95	105	70	105	65	94	68
29	80	108	110	70	108	66	98	61
31	88	99	110	80	114	72	95	69
32	87	107	120	70	109	68	103	72
33	75	97	80	55	84	55	76	56
34	74	94	95	65	90	54	81	55
35	63	73	125	80	115	75	103	75
36	55	60	95	60	96	59	97	63
38	73	80	115	80	99	77	94	71
41	62	76	95	60	96	52	85	48
43	86	101	118	80	117	73	100	67
48	54	70	80	55	83	51	76	52
49	72	74	120	80	118	79	113	79
50	96	103	120	85	118	77	107	73
51	74	88	100	75	94	57	89	71
52	83	98	118	90	119	79	109	82
53	84	101	120	80	116	81	100	76
54	76	87	110	76	100	59	91	60
56	77	95	100	75	87	62	76	65
57	81	97	95	70	93	68	92	68
58	70	88	104	70	105	69	98	71
59	72	79	105	70	106	72	97	73
60	67	67	120	80	113	80	113	86
61	79	79	120	80	113	89	111	77
62	74	74	98	70	94	56	91	59
63	76	82	110	80	104	67	99	67
64	91	117	105	75	105	64	97	66
65	60	60	140	90	137	91	131	93
66	71	83	120	80	113	82	108	84
67	59	72	110	80	97	73	93	70
68	72	91	90	60	93	63	83	67

TABLE IV LBNP TEST HEART RATE AND BLOOD PRESSURE DATA

SUBJ	HR-SUP bpm	HR-MAX bpm	S-CLIN mm Hg	D-CLIN mm Hg	S-SUP mm Hg	D-SUP mm Hg	S-MAX mm Hg	D-MAX mm Hg
69	57	64	150	85	89	70	96	74
70	72	76	108	70	99	72	96	71
72	69	89	108	60	96	67	85	71
73	78	87	95	70	88	61	82	60
74	65	80	120	80	122	83	107	79
75	84	101	105	80	102	66	92	65
76	69	81	115	78	102	70	102	79
77	88	94	110	80	110	72	100	67
78	73	99	98	75	84	61	82	62
80	81	87	108	78	112	73	106	73
81	77	90	104	70	102	64	95	63
83	79	86	140	85	128	79	117	81
84	102	120	130	75	118	73	115	79
85	76	77	120	80	104	71	119	67
86	84	125	100	68	97	59	88	56
87	69	85	107	70	103	70	94	71
88	71	74	110	64	113	70	102	60
90	65	69	105	70	94	60	88	62
91	71	88	98	65	94	58	79	60
92	62	68	120	70	96	74	96	73
93	62	82	102	84	102	63	100	71
94	70	76	116	72	117	75	110	69
96	88	118	100	70	103	65	82	59
97	67	82	98	70	91	63	91	69
98	64	77	100	66	101	54	93	55
100	53	77	80	60	78	59	66	52
101	64	74	100	70	93	65	92	72
102	67	78	115	80	95	72	94	74
107	73	78	82	58	85	54	83	62
108	74	94	95	60	90	60	88	65
109	79	98	105	70	101	66	90	63
110	85	106	90	55	100	56	105	64
111	95	105	95	60	98	55	91	58
112	65	70	110	70	118	73	104	70
113	64	74	98	70	100	58	102	67
115	72	86	130	80	119	79	113	82
116	64	72	88	60	86	55	80	58
117	75	103	110	70	104	71	93	75
118	88	107	110	70	102	70	93	73
123	65	70	100	60	103	57	96	57
124	95	110	105	65	105	62	82	53
127	82	85	88	50	91	47	78	43
144	79	106	118	70	114	67	109	71
146	63	72	100	60	92	71	81	60
147	69	91	98	65	101	67	87	62
153	62	71	95	60	87	59	80	59
155	80	98	105	75	105	69	102	73
156	61	90			92	58	87	63
158	66	79	95	68	89	61	82	64

TABLE V LBNP TEST PERFORMANCE DATA

SUBJ	LCC cm	RCC cm	CHANGE LLV %	CHANGE RLV %	LLV ml
1	31.6	31.2	1.3	1.0	
4	32.4	33.0	1.1	1.1	
5	36.1	37.0	.7	1.3	
6	31.5	32.0	1.2	1.1	
7	32.3	32.1	1.6	.8	7595
8	31.1	31.6	.4	.4	5925
9	34.1	34.4	1.0	1.8	8310
15	33.5	34.1	1.1	1.4	7385
16	32.5	32.8	1.3	1.6	7251
18	34.0	34.0	2.0	1.8	5929
19	33.0	32.1	1.3	1.7	6677
20	31.3	32.7	.4	1.0	6945
21	38.9	38.8	1.8	1.5	5054
23	32.3	31.0	.3	.9	7035
24	31.3	31.7	1.1	.9	6210
25	28.5	29.2	.4	1.0	5899
26	35.0	35.2	.6	1.8	8221
27	30.8	31.3	2.2	1.5	6934
28	35.7	36.3	1.3	1.0	7848
29	31.8	31.5	.9	2.3	6195
31	34.2	33.5	.2	.6	7742
32	36.8	36.2	1.3	1.0	8942
33	33.1	33.6	2.0	2.6	6688
34	29.1	29.3	1.1	1.0	5740
35	37.2	37.5	3.4		9135
36	34.9	34.7	3.3	1.7	7735
38	32.4	32.6	.6	1.3	6966
41	31.2	31.0	1.5	1.5	6095
43	31.3	31.4	1.7	1.4	6533
48	32.0	31.6	2.8	3.7	6602
49	35.4	35.5	1.3	1.6	8076
50	33.5	34.6	1.1	.7	7158
51	34.7	33.9	.9	1.2	7340
52	40.2	40.9	2.0	1.7	9280
53	32.9	33.1	.7	.9	7798
54	34.4	33.8	1.1	1.9	7503
56	36.1	36.1	1.0	.8	9181
57	30.6	31.0	1.8	1.8	5806
58	36.2	36.2	2.0	1.9	8696
59	33.5	33.7	.5	.6	7397
60	36.7	36.9	1.3	1.0	8239
61	32.2	33.0	2.6	1.7	6132
62	32.3	31.2	5.5	1.9	7140
63	33.4	32.7	1.2	1.3	7795
64	33.1	34.5	.9	1.0	7090
65	36.2	36.8	1.5	2.0	7301
66	37.0	36.2	2.9	1.6	8960
67	36.2	36.3	1.1	2.4	7695
68	34.6	35.4	.6	.5	7969

TABLE V LBNP TEST PERFORMANCE DATA

SUBJ	LCC cm	RCC cm	CHANGE LLV %	CHANGE RLV %	LLV ml
69	33.4	33.0	1.5	1.2	7319
70	33.0	32.5	.3	.6	7194
72	38.1	37.3	.8	1.4	7665
73	33.0	33.3	.4	.8	7049
74	35.4	35.7	.4	1.0	8457
75	36.9	37.4	.6	1.2	8900
76	36.1	36.4	1.4	1.5	8306
77	32.7	33.4	2.6	1.7	6232
78	33.5	34.4	.9	.7	7474
80	36.7	36.4	1.0	1.3	8910
81	33.9	34.0	1.0	1.1	7919
83	36.5	35.9	2.8	1.9	8120
84	36.3	36.0	1.4	1.2	7736
85	34.2	33.8	1.2	.9	7521
86	36.5	36.4	1.2	.9	8399
87	34.9	35.1	.6	1.3	8022
88	33.8	33.2	1.5	1.0	8500
90	30.4	30.7	2.3	1.1	6390
91	32.0	32.3	1.5	1.9	6391
92	30.4	29.8	1.7	1.7	6413
93	32.6	33.0	1.4	.8	6571
94	32.6	31.7	1.7	2.8	5461
96	32.2	32.6	1.1	1	6361
97	33.8	33.8	.8	1.1	8011
98	31.7	31.7	.8	2.0	6553
100	31.7	31.7	.9	2.5	6582
101	35.7	35.4	1.3	1.6	7094
102	40.5	40.4	1.0	.9	10083
107	32.0	31.4	1.7	4.9	6533
108	31.6	32.2	1.6	1.2	5357
109	33.5	34.2	2.9	3.1	6900
110	32.6	32.7	1.0	.7	6668
111	35.3	36.0		1.0	8776
112	35.5	36.3	1.3	.9	9128
113	33.7	32.7	1.1	.7	7556
115	33.4	34.0	2.1	1.3	8218
116	33.4	34.5	1.6	1.7	7320
117	38.3	37.9	1.7	2.3	9012
118	41.2	41.9	.9	.6	11021
123	35.5	35.0	1.4	1.9	8261
124	36.0	35.5	.3	.6	7158
127	31.6	31.4	2.3	1.1	5347
144	31.3	31.6	.9	1.2	6358
146	32.6	33.1	1.0	1.3	6364
147	37.8	38.3	1.2	1.0	9590
153	33.0	32.6	1.5	2.0	7376
155	37.0	36.5	.7	.9	9844
156	33.3	34.0	2.6	3.3	6986
158	34.9	34.0	.4	.8	8097

TABLE VI TREADMILL TEST HEART RATE AND OXYGEN USE DATA

SUBJ	HR-SUP bpm	HR-STN bpm	HR-HYV bpm	HR-MAX bpm	HR-R2 bpm	HR-R5 bpm	V-O2 ml/kg/min	DUR EXER min
1	67	96	138	180	94	92		7.0
4	73	95		181	125	108		8.0
5	72	89	100	161	119	94	22.3	7.0
6	81	99	120	177	123	106		12.0
7	84	80		183	97	89	19.1	7.0
8	88	93	98	184	118	102	26.8	9.0
9	70	75		187	116	96	28.7	6.0
15	64	70	108	182	110	95	19.5	8.0
16	68	93	135	167	116	95	28.4	10.0
18	77	109	137	182	121	104	31.2	12.0
19	104	122	134	176	134	121	20.8	9.0
20	55	60	105	171	124	94	25.2	9.0
21	68	71	90	179	119	99	22.7	8.0
23	60	79	110	180	136	111		10.0
24	80	95	156	194	157	122	31.0	10.0
25	85	139	148	198	150	138	30.4	12.0
26	76	91	146	185	137	114	26.2	10.0
27	80	96	106	157	120	103	22.4	7.0
28	68	76	126	182	120	100	28.7	8.0
29	80	93	141	212	117	98	36.8	14.0
31	74	96	147	193	124	106	31.3	11.0
32	87	112	148	199	140	108	31.1	11.0
33	71	86	117	182	132	106	32.3	11.0
34	72	92	122	170	104	86	21.8	7.0
35	62	73	92	173	112	89	20.8	9.0
36	50	63	97	180	113	87	33.2	12.0
38		83	150	187	126	104	27.1	9.0
41	66	88	120	193	128	102	32.6	11.0
43	82	121	169	189	145	124	33.1	11.0
48	51	70	118	189	124	97		11.0
49	67	89	113	191	134	111	27.9	10.0
50	83	110	140	184	140	112	36.5	10.0
51	66	94	155	174	129	109	37.7	11.0
52	82	87	141	186	146	124	35.6	8.0
53	94	114	143	204	141	126	41.5	11.0
54	69	86	144	194	121	109	30.9	10.0
56	77	102	120	174	142	97	32.9	8.0
57	84	92	145	181	101	99	29.5	9.0
58	64	91	148	191	149	105	27.9	12.0
59	68	83	135	174	149	112	23.6	9.0
60	68	71	108	166	111	96	20.5	7.0
61	71	73	86	163	124	95	22.0	8.0
62	72	75	128	155	101	89	21.8	8.0
63	82	93	165	185	114	105	32.1	9.0
64	89	117	170	187	98	125	35.2	10.0
65	62	63	108	171	120	111	37.6	11.0
66	83	109	175	198	178	132	32.6	10.0
67	57	63	109	165	132	83	32.0	10.0
68	71	78	105	153	108	94	26.1	7.0

TABLE VI TREADMILL TEST HEART RATE AND OXYGEN USE DATA

SUBJ	HR-SUP bpm	HR-STN bpm	HR-HYV bpm	HR-MAX bpm	HR-R2 bpm	HR-R5 bpm	V-O2 ml/kg/min	DUR EXER min
69	59	79	100	163	144	91	33.3	8.0
70	75	92	133	182	164	122	32.1	8.0
72	67	92	118	186	164	109	33.3	9.0
73	82	88	111	178	159	109	27.8	7.0
74	64	70	118	177	145	95	42.0	12.0
75	80	98	135	183	158	117	34.5	8.0
76	67	81	143	188	145	108	34.2	10.0
77	74	96	130	200	166	125	38.8	9.0
78	68	95	140	192	170	114	38.3	9.0
80	78	89	140	191	171	124	43.7	11.0
81	80	90	156	178	145	106	32.0	8.0
83	69	76	130	173	130	94	25.9	6.0
84	118	121	160	191	180	131	33.9	9.0
85	74	83	112	170	147	106	28.0	8.0
86	83	107	148	194	166	110	37.5	9.0
87	68	89	131	192	165	116	44.6	14.0
88	67	82	150	173	142	98	45.1	10.0
90	59	71	98	171	109	80	28.9	8.0
91	65	84	138	192	115	98	28.5	9.0
92	64	70	132	153	101	83	22.7	6.0
93	60	70	110	202	110	98	50.4	15.0
94	68	74	118	163	140	94	21.4	7.0
96	84	112	147	193	167	109	34.4	10.0
97	66	76	137	164	110	102	23.0	7.0
98	64	76	150	187	151	97	36.1	12.0
100	49	64	100	163	125	73		7.0
101	64	82	138	172	139	89	28.2	9.0
102	62	79	132	182	141	99	26.5	10.0
107	72	81	130	184	149	103	33.4	11.0
108	76	87	119	175	147	104	28.3	7.0
109	69	100	156	179	164	108	24.1	7.0
110	80	106	190	195	165	110	34.4	12.0
111	101	113	180	186	158	120	30.0	8.0
112	69	76	138	177	157	113	27.0	8.0
113	62	74	146	161	126	94	28.0	7.0
115	82	85	139	160	140	104	27.0	7.0
116	64	76	160	184	150	91	29.3	10.0
117	81	90	155	188	159	112	23.2	6.0
118	88	104	154	184	123	115	32.9	9.6
123	80	73	136	180	138	94	26.3	9.8
124	91		162	176	110	104	18.5	7.0
127	95	145	170	196	157	122	31.8	10.0
144	80	83	130	180	159	102	30.0	8.0
146	54	61	108	169	144	75	33.8	8.0
147	68	82	96	166	137	100	30.6	6.6
153	62	79	135	182	123	106	34.4	10.5
155	89	94	135	186	109	102	27.9	9.0
156	60	80	130	181	120	101	37.3	15.1
158	70	76	132	181	137	103	34.0	11.3

TABLE VII TREADMILL TEST BLOOD PRESSURE DATA

SUBJ	S-SUP mm Hg	D-SUP mm Hg	S-STN mm Hg	D-STN mm Hg	S-MAX mm Hg	D-MAX mm Hg	S-R2 mm Hg	D-R2 mm Hg	S-R5 mm Hg	D-R5 mm Hg
1	98	63	105	75			112	29	103	
4	96	75	117	77	158	77	173	91	142	76
5	80	71	103	72	160	70	169	60	116	61
6	110	58	130	69			139	46	112	47
7	117	67	114	90	232	75	143	93	114	89
8	109	76	106	80	210	75	119	76	103	75
9	112	59	103	64	200		152	62	125	59
15	87	61	84	73	116		123	55	95	60
16	98	78	106	81	130		119	68	96	64
18	101	55	103	68	138	60	153	57	118	56
19	134	83	139	92	155	75	155	66	130	70
20	106	71	105	82	182	60	186	77	130	67
21	115	74	118	79			173	49	123	60
23	112	76	107	80	146	86	140	54	115	57
24	102	61	111	65	146		176		127	50
25	114	66	136	62	204	50	164		134	52
26	95	72	108	66	172	67	140	49	133	54
27	95	56	95	66	167	72	142	58	122	62
28	102	76	103	84	150	99	142	71	112	71
29	103	60	112	76	164	80	157	50	141	49
31	99	70	120	80	148	90	147	75	121	69
32	108	58	136	60	150	70	161	46	115	
33	94	61	95	63	120	66	138	59	117	60
34	90	50	97	65	128	70	115	50	89	53
35	114	78	108	84	160		178	85	141	78
36	92	54	98	62	150	76	166	53	126	46
38	91	46	95	81	146	80	129	69	98	75
41	94	49	105	60	144	70	172	46	118	45
43	140	64	141	95	174	68	171	64	137	59
48	93	53	94	71	146	66		57	110	59
49	108	73	140	92	190	96	184	68	135	68
50	119	82	115	88	130	84	177	89	131	72
51	101	70	111	81	156		145	68	120	65
52	111	60	123	91	144	94	157	62	138	61
53	110	74	116	80	166	92	159	57	125	66
54	108	68	116	70	158	84	170	60	161	61
56	90	56	100	72	140	80	120	60	108	60
57	90	63	97	59	150	74	120	58	89	59
58	95	64	91	80	156	80	156	80	135	65
59	110	74	105	79	176	90	148	78	132	75
60	112	78	122	88	171	60	146	82	129	79
61	118	81	119	88	164	88	178	88	145	84
62	105	54	104	69	148	80	140	64	105	53
63	104	60	121	76	148	80	154		121	47
64	114	62	112	68	140	68	237		154	
65	128	89	143	94	210	99	209	93	167	87
66	129	90	152	97	186	94	125	41	155	74
67	92	70	108	81	155	80	151	75	113	57
68	94	62	108	62	152		125	71	110	68

TABLE VII TREADMILL TEST BLOOD PRESSURE DATA

SUBJ	S-SUP mm Hg	D-SUP mm Hg	S-STN mm Hg	D-STN mm Hg	S-MAX mm Hg	D-MAX mm Hg	S-R2 mm Hg	D-R2 mm Hg	S-R5 mm Hg	D-R5 mm Hg
69	106	80	135	92	170	80	166	72	122	64
70	99	75	134	68	154	83			110	64
72	100	70	104	66	162		154	68	126	68
73	97	62	97	67	130		126	70	123	63
74	122	79	123	84	144		165	59	134	63
75	102	64	107	80	150	86	138	84	124	58
76	108	86	118	89			178	86	148	86
77	113	52	102	80	130	70	145	80	122	78
78	81	62	88	68	160	70	140	80	111	64
80	107	62	111	84			158	80	147	66
81	110	78	118	76	158				131	62
83	113	79	125	86	140		150	45	150	70
84	125	77	161	87	173				160	50
85	111	73	135	73			152	55	147	66
86	98	59	96	61	160	70	145	65	121	61
87	110	60	116	60	160	90	148	82	120	50
88	126	83	150	70	168				182	66
90	112	48	124	66	170	70	130	58	104	50
91	110	50	98	50			182	52	130	50
92	95	50	102	62	144	74	148	58	106	56
93	96	65	115	78	169	62	158	65	116	62
94	95	71	96	75	168		144	60	123	
96	89	61	97	72	155	75	153		109	86
97	99	72	93	65	144	70	139	80	125	49
98	101	54	113	65	170	74	140	60	137	52
100	82	59	91	69	132	61	132	61	111	63
101	94	69	104	69	148		133	59	103	69
102	91	67	105	89	160		130			
107	81	58	81	59	160	70	134	64	122	42
108	85	71	98	83			130	58	104	57
109	98	87	97	84	190	88	136	73	112	70
110	95	61	102	64	163	70	149	58	141	49
111	104	76	105	72	141		138		119	54
112	124	63	118	62					127	59
113	111	66	107	75	153	59	157	58	121	60
115	139	92	151	89	202	99	176	98	133	83
116	112	62	104	73	172	82			98	57
117	90	83	104	90	220				120	70
118	107	75	122	78	176		162	52	121	74
123	104	58	105	59	160	74	140	66	119	60
124	108	80	117	76	152	70			111	73
127	99	52	92	64	150	70	142	64	107	54
144	128	79	125	88	162	75	150		130	75
146	89	62	100	67	160	85	140	75	103	66
147	104	63	109	67			140	70	116	71
153	99	65	104	79	148		154	60	110	65
155	106	72	109	69			135	71	97	64
156		59	96	68	174	70	162	75	124	60
158	112	75	101	58	154	70	144	62	107	59

TABLE VIII ANOMALOUS EVENTS DURING LBNP TESTS

PRESYNCOPE

SUBJ	TIME min	LEVEL mm Hg
24	3:00	-30
31	2:50	-30
86	4:00	-50
88	4:00	-40
91	3:50	-50
124	3:15	-50
145	4:30	-50
157	1:25	-50

ARRHYTHMIAS

SUBJ	TYPE	CHARACTERIZATION
18	PAC	4, recovery
19	PAC	2, recovery
31	PAC	multiple, unifocal
52	PAC	3
65	PAC	2
68	PVC	multiple
69	PAC	multiple
81	PVC	1, -50 mm Hg
92	PAC	2, recovery
93	PAC	1, recovery
125	PVC	multiple,1 couplet
147	PAC	multiple

TABLE IX SUBJECT AND TEST DESCRIPTIVE DATA
(Repeat tests)

SUBJ	TEST DATE	AGE years	HEIGHT cm	WEIGHT kg	T-oral deg F	T-room deg F
22	10Dec76	50	165.0	55.3	98.0	77.0
1	13Oct76	25	163.0	46.7	98.2	74.0
19	7Dec76	35	163.0	49.9	98.0	74.0
21	9Dec76	22	158.0	74.8	98.4	75.0
9	24Nov76	35	163.0	59.0	98.4	72.0
25	15Dec76	27	158.0	46.3	97.8	73.0
23	13Dec76	37	165.0	54.4	98.2	67.0
20	8Dec76	45	173.0	59.0	98.2	74.0
27	17Dec76	61	158.0	49.9	98.4	74.0
28	20Dec76	28	164.0	68.0	98.0	75.0
33	5Jan77	37	159.0	53.6	98.0	74.0
24	14Dec76	23	165.0	54.0	97.8	73.0
6	19Nov76	24	163.0	48.5	98.0	73.0
34	6Jan77	32	168.0	53.5	98.0	73.0
15	2Dec76	24	165.0	56.2	98.4	
107	15Mar77	33	163.6	52.6	97.8	71.0
68	7Feb77	34	164.4	65.1	98.0	74.0
	N	17	17.0	17.0	17.0	16.0
	Mean	33.6	163.4	55.7	98.1	73.3
	SD	10.5	3.8	7.7	.2	2.2
142	12Apr77	51	160.7	58.2	97.8	71.5
143	13Apr77	25	165.1	48.0	98.0	72.0
145	14Apr77	35	160.2	52.3	98.0	72.0
148	19Apr77	23	158.0	81.3	97.8	71.5
149	19Apr77	36	164.0	60.0	97.8	73.0
150	20Apr77	27	158.0	44.3	97.8	72.0
151	20Apr77	37	164.0	54.8	98.0	73.0
152	21Apr77	45	173.5	62.1	97.6	70.5
157	26Apr77	61	157.8	50.0	97.6	71.0
159	27Apr77	28	166.8	70.1	97.8	70.0
161	28Apr77	38	160.0	53.0	98.0	70.5
164	4May77	24	165.5	56.1	98.8	72.0
165	5May77	25	162.3	48.1	98.6	71.5
119	29Mar77	31	165.5	52.0	98.0	74.5
120	29Mar77	24	165.0	57.5	97.8	74.5
122	29Mar77	33	160.5	54.4	99.2	75.0
125	30Mar77	34	159.4	63.3	98.4	75.0
	N	17	17.0	17.0	17.0	17.0
	Mean	33.9	162.7	56.8	98.1	72.3
	SD	10.4	4.1	9.0	.4	1.6

TABLE X SUBJECT AND TEST HISTORICAL DATA
(Repeat Tests)

SUBJ	MENSTRUAL HISTORY		MEDICATIONS	LIFE STYLE		SLEEP/EAT TIME	
	Cycle day/length/none			smoke	exer	Hours	Hours
22			HY-12 estrog, diur	1	1	5.5	2.0
1	25	28				8.5	12.0
19	12	30		2	1	11.0	1.5
21	30	31		1		6.5	10.5
9	21	30		1	2	8.5	14.0
25	18	30		2	1	7.5	14.0
23	14	30		1	2	5.5	2.0
20			PM-1.5	2	1	6.0	16.0
27			PM-5	1	1	7.0	1.5
28	14	30		1	2	6.0	12.5
33	14	30		1	2	7.0	5.0
24	11	30		2	2	6.0	12.0
6	11	28		2	2	7.0	11.5
34	33	35		1	2	7.0	10.0
15	16	30		2	1	7.0	14.0
107	14	32		1	2	6.0	11.0
68	7	28		1	2	7.0	11.0
N	14	14		16	15	17.0	17.0
Mean	17	30		1	2	7.0	9.4
SD	8	2		1	1	1.4	5.0
142			HY-13 estrog, diur	1	1	6.0	2.5
143	12	28	oral contrac	2	2	7.0	12.0
145	26	28		2	1	6.0	13.0
148	10	28		1		8.5	14.0
149	6	28		1	2	7.0	14.0
150	26	30		2	1	5.0	12.0
151	9	26		1	2	5.0	3.0
152			PM-2	2	1	6.0	11.0
157			PM-5	1	2	7.0	2.0
159	15	30		1	2	6.5	12.0
161	21	28		1	2	6.0	13.0
164	14	30		2	2	8.0	20.0
165	27	28		2	2	8.5	2.5
119			DC-2mon	1	2	7.0	15.0
120	20	29		2	1	7.5	2.0
122	29	32		1	2	5.0	5.0
125	1	28		2		8.0	16.0
N	13	13		17	15	17.0	17.0
Mean	17	29		1	2	6.7	9.9
SD	10	2		1	1	1.2	6.2

TABLE XI BLOOD AND PULMONARY TEST DATA (Repeat tests)

SUBJ	HGB gm %	HCR	T-CHOL mg %	TRIG mg %	FEV-1 L	FVC L	FOF %	VC L
22	13.1	40	217	89				
1	13.1	39	175	116	3.10	3.61	85	3.39
19	12.1	38	227	43				
21	12.9	39	147	108	2.16	2.63	82	2.53
9	13.4	40	149	63	3.25	3.88	83	3.67
25	12.3	38	226	61	2.55	2.70	94	2.69
23	13.1	40	149	65	2.86	3.25	88	2.89
20	10.1	32	175	52	3.57	3.88	92	3.78
27	13.4	41	150	100				
28	13.8	41	165	95	2.86	3.37	84	3.20
33	13.7	41	239	93	2.63	3.33	78	3.43
24	13.2	40	163	51	3.76	4.08	92	3.78
6	14.0	41	247	59	3.08	3.52	87	3.55
34	15.0	44	167	54	3.57	4.19	85	3.90
15	12.5	40	215	78	3.25	3.65	89	3.67
107	13.0	39	223	64	2.63	3.45	76	3.32
68	12.8	39	223	43	2.04	2.39	85	3.35
N	17.0	17	17	17	14.00	14.00	14	14.00
Mean	13.0	40	191.6	73	2.95	3.42	86	3.37
SD	1.0	2	36.2	23	.52	.54	5	.42
142								
143	12.2	39	214	87				
145								
148								
149								
150								
151								
152								
157	12.8	40	212	89				
159								
161	12.7	39	233	77				
164								
165								
119	13.7	43	178	50				
120	12.7	40	156	57				
122	12.7	41	214	107				
125	12.6	39	203	51				
N	7.0	7	7	7				
Mean	12.8	40	201.4	74				
SD	.6	2	31.8	27				

TABLE XII LBNP TEST HEART RATE AND BLOOD PRESSURE DATA
(Repeat tests)

SUB	HR-SUP bpm	HR-MAX bpm	S-CLIN mm Hg	D-CLIN mm Hg	S-SUP mm Hg	D-SUP mm Hg	S-MAX mm Hg	D-MAX mm Hg
22	66	73	110	70	103	75	95	75
1	77	86	103	66	99	62	97	63
19	93	112	110	70	104	72	98	74
21	70	88	104	74	108	73	101	73
9	73	88	106	60	100	68	100	71
25	95	105	110	70	109	55	103	57
23	63	70	98	60	95	66	95	70
20	54	61	99	72	97	72	96	73
27	85	96	95	60	99	65	97	68
28	73	95	105	70	105	65	94	68
33	75	97	80	55	84	55	76	56
24	78	82	102	62	96	56	72	54
6	90	103	108	60	104	58	111	71
34	74	94	95	65	90	54	81	55
15	69	93	94	65	86	61	77	61
107	73	78	82	58	85	54	83	62
68	72	91	90	60	93	63	83	67
N	17	17	17	17	17	17	17	17
Mean	75.3	88.9	99.5	64.5	97.5	63.2	91.7	65.8
SD	10.6	13.1	9.2	5.6	7.8	7.1	10.9	7.1
142	61	70	100	60	90	58	84	61
143	72	80	95	60	89	54	94	56
145	75	107	98	56	98	64	85	59
148	70	91	108	70	107	66	91	58
149	69	91	108	70	101	69	96	70
150	77	85	95	65	100	62	92	59
151	64	75	90	55	83	56	86	59
152	57	66	110	70	88	58	89	61
157	73	92	90	60	88	57	59	41
159	73	93	100	65	92	62	90	68
161	72	91	84	44	83	51	76	53
164	77	96			94	51	86	44
165	79	87	90	60	96	51	103	63
119	66	82	88	50	81	51	73	52
120	61	90	90	50	78	51	70	50
122	74	77	80	56	88	52	89	51
125	65	77	98	60	93	61	84	61
N	17	17	16	16	17	17	17	17
Mean	69.7	85.3	95.3	59.4	91.1	57.3	85.1	56.8
SD	6.8	11.0	9.3	8.1	8.3	6.3	11.3	8.2

TABLE XIII LBNP TEST PERFORMANCE DATA
(Repeat Tests)

SUBJ	LCC cm	RCC cm	CHANGE LLV %	CHANGE RLV %	LLV ml
22	34.4	34.5	2.1	1.7	7299
1	31.6	31.2	1.3	1.0	
19	33.0	32.1	1.3	1.7	6677
21	38.9	38.8	1.8	1.5	5054
9	34.1	34.4	1.0	1.8	8310
25	28.5	29.2	.4	1.0	5899
23	32.3	31.0	.3	.9	7035
20	31.3	32.7	.4	1.0	6945
27	30.8	31.3	2.2	1.5	6934
28	35.7	36.3	1.3	1.0	7848
33	33.1	33.6	2.0	2.6	6688
24	31.3	31.7	1.1	.9	6210
6	31.5	32.0	1.2	1.1	
34	29.1	29.3	1.1	1.0	5740
15	33.5	34.1	1.1	1.4	7385
107	32.0	31.4	1.7	4.9	6533
68	34.6	35.4	.6	.5	7969
N	17.0	17	17	17	15
Mean	32.7	32.9	1.2	1.5	6835
SD	2.5	2.5	.6	1.0	880
142	34.2	34.5			7096
143	32.0	31.9	1.6	.4	6469
145	34.0	32.8	1.3	1.5	6548
148	39.0	38.7	2.1	2.2	5739
149	35.1	34.9	1.4	1.6	7891
150	29.1	29.2	1.9	1.6	5472
151	32.4	31.0	.3	1.0	7088
152	31.3	32.2	.9	.9	6851
157	31.6	31.5	1.4	.4	6307
159	35.5	36.0	1.9	.8	6785
161	33.3	33.5	2.5	3.0	5369
164	32.1	32.6	5.0	2.7	6979
165	32.1	32.3	3.4	1.6	6311
119	29.0	29.1	.8	.9	5973
120	34.3	34.7	.4	1.3	7448
122	32.5	32.0	.7	1.1	6688
125	34.7	35.4	1.5	.6	7631
N	17.0	17	16	16	17
Mean	33.1	33.1	1.7	1.4	6626
SD	2.6	2.6	1.3	.8	769

TABLE XIV TREADMILL TEST HEART RATE AND OXYGEN USE DATA (Repeat Tests)

SUBJ	HR-SUP bpm	HR-STN bpm	HR-HYV bpm	HR-MAX bpm	HR-R2 bpm	HR-R5 bpm	V-O2 ml/kg/min	DUR EXER min
22	62	65	91	151	101	86		9.0
1	67	96	138	180	94	92		7.0
19	104	122	134	176	134	121	20.8	9.0
21	68	71	90	179	119	99	22.7	8.0
9	70	75		187	116	96	28.7	6.0
25	85	139	148	198	150	138	30.4	12.0
23	60	79	110	180	136	111		10.0
20	55	60	105	171	124	94	25.2	9.0
27	80	96	106	157	120	103	22.4	7.0
28	68	76	126	182	120	100	28.7	8.0
33	71	86	117	182	132	106	32.3	11.0
24	80	95	156	194	157	122	31.0	10.0
6	81	99	120	177	123	106		12.0
34	72	92	122	170	104	86	21.8	7.0
15	64	70	108	182	110	95	19.5	8.0
107	72	81	130	184	149	103	33.4	11.0
68	71	78	105	153	108	94	26.1	7.0
N	17	17	16	17	17	17	13	17
Mean	72	87	119	177	123	103	26.4	8.9
SD	11	20	19	13	18	14	4.7	1.9
142	54	63		160	120	92	29.0	9.4
143	65	80		188	112	109	35.0	10.0
145	88	102	132	168	151	112	34.9	7.7
148	62	73	140	189	131	108	26.3	11.0
149	73	90	140	204	125	120	41.7	13.5
150	80	98	145	202	162	138	37.4	13.6
151	57	70	120	214		115	42.4	10.8
152	62	72	108	176	132	99	30.0	11.0
157	81	105	108	171	148	124	30.1	8.0
159	70	88	150	176	118	99	30.0	7.6
161	75	79	114	182	129	105	34.9	11.0
164	78	90		204	168	128	39.3	12.6
165	74	88	126	191	130	103	32.5	15.7
119	69	96	120	161	107	86	25.1	7.5
120	61	81	146	190	173	111	29.4	9.3
122	82	92	140	182	142	114	31.0	10.0
125	77	81	130	185	158	108	36.2	9.8
N	17	17	14	17	16	17	17	17
Mean	71	85	130	185	138	110	33.2	10.5
SD	10	13	15	16	22	14	5.4	2.5

TABLE XV TREADMILL TEST BLOOD PRESSURE DATA
(Repeat Tests)

SUBJ	S-SUP mm Hg	D-SUP mm Hg	S-STN mm Hg	D-STN mm Hg	S-MAX mm Hg	D-MAX mm Hg	S-R2 mm Hg	D-R2 mm Hg	S-R5 mm Hg	D-R5 mm Hg
22	99	73	89	81	158	70	151	84	119	78
1	98	63	105	75			112	29	103	
19	134	83	139	92	155	75	155	66	130	70
21	115	74	118	79			173	49	123	60
9	112	59	103	64	200		152	62	125	59
25	114	66	136	62	204	50	164		134	52
23	112	76	107	80	146	86	140	54	115	57
20	106	71	105	82	182	60	186	77	130	67
27	95	56	95	66	167	72	142	58	122	62
28	102	76	103	84	150	99	142	71	112	71
33	94	61	95	63	120	66	138	59	117	60
24	102	61	111	65	146		176		127	50
6	110	58	130	69			139	46	112	47
34	90	50	97	65	128	70	115	50	89	53
15	87	61	84	73	116		123	55	95	60
107	81	58	81	59	160	70	134	64	122	42
68	94	62	108	62	152		125	71	110	68
N	17	17	17	17	14	10	17	15	17	17
Mean	103	65	106	72	156	72	145	60	117	56
SD	13	9	17	10	26	13	21	14	12	17
142	73	60	88	58	150	70			112	70
143	100	59	107	68	125	65	132	50	119	59
145	106	68	129	66	155	50			129	64
148	104	70	100	72	160				114	
149	105	70	110	70	172	88	141	75	128	60
150	107	65	101	63	140	72	163	61	145	53
151	90	62	103	66	122	60			122	65
152	98	71	105	87	180	70	169	72	119	68
157	87	57	100	71	144	62	159	54	127	67
159	97	73	94	74			131	79	101	78
161	87	58	96		138	68	127	57	114	59
164	97	54	98	63	166	70	158	52	148	
165	105	55	100	78	150	60	137	65	104	48
119	89	70	91	72	132	76	122	76		
120	84	54	89	63	164	63	148	50	125	55
122	90	57	96	66	140	78	128	70	121	58
125	100	66	132	68	158	62	144	60	122	60
N	17	17	17	16	16	15	13	13	16	14
Mean	95	63	102	69	150	68	143	63	122	62
SD	10	7	13	7	18	10	17	11	13	8

TABLE XVI LBNP TEST SYSTOLIC TIME INTERVALS

SUBJ	PEP/LVET		HR-INST	
	Rest	MaxLBNP	Rest	MaxLBNP
1				
4	.393	.512	86	101
5	.337	.317	72	71
6	.236	.287	90	108
7	.224	.404	73	94
8	.330	.423	72	117
9	.278	.387	73	99
15	.263	.565	67	109
16	.343	.620	71	90
18	.275	.537	78	120
19	.320	.442	92	112
20	.339	.353	55	63
21	.224	.404	73	94
23	.332	.405	61	70
24	.298	.272	77	79
25	.381	.622	84	106
26	.345	.520	75	87
27	.282	.442	79	97
28	.384	.524	70	105
29	.272	.472	78	115
31	.301	.448	82	101
32	.263	.431	86	107
33	.242	.490	75	105
34	.267	.399	71	90
35	.362	.510	60	78
36	.243	.325	54	56
38	.323	.348	71	78
41	.276	.485	58	75
43	.247	.447	79	106
48	.375	.480	53	69
49	.262	.404	73	76
50	.340	.444	96	102
51	.377	.514	68	82
52	.220	.342	79	102
53	.289	.428	81	103
54	.267	.377	71	90
56	.381	.393	79	101
57	.313	.487	79	100
58	.268	.440	68	88
59	.304	.260	70	78
60				
61	.343	.442	78	89
62	.250	.339	70	74
63	.271	.400	76	77
64	.348	.508	91	118
65	.242	.403	63	60
66	.316	.485	72	86
67	.316	.357	59	60
68				

TABLE XVI LBNP TEST SYSTOLIC TIME INTERVALS

SUBJ	PEP/LVET Rest	PEP/LVET MaxLBNP	HR-INST Rest	HR-INST MaxLBNP
69	.280	.348	55	63
70	.281	.424	73	81
72	.227	.329	69	89
73	.335	.452	79	91
74	.313	.349	63	80
75	.310	.447	83	110
76	.343	.461	68	85
77	.258	.399	71	100
78	.288	.442	74	108
80	.280	.379	74	84
81	.283	.412	75	88
83	.281	.448	78	86
84	.230	.282	104	120
85	.238	.298	79	81
86				
87	.301	.412	63	84
88	.323	.402	72	74
90	.246	.363	63	70
91	.232	.309	64	84
92	.277	.417	60	67
93	.324	.508	62	86
94	.269	.341	70	78
96	.247	.471	84	119
97	.299	.386	68	83
98	.283	.396	66	85
100	.274	.438	54	82
101	.378	.491	62	75
102	.360	.410	65	79
107	.357	.454	75	81
108	.295	.393	76	101
109	.289	.480	81	109
110	.274	.424	85	110
111	.228	.390	94	101
112	.263	.390	64	80
113	.223	.311	63	75
115	.305	.413	70	88
116	.185	.396	65	72
117				
118	.235	.382	90	111
123	.251	.349	68	67
124	.401	.524	95	115
127	.224	.298	80	87
144	.326	.426	79	129
146	.280	.456	63	77
147	.327	.446	71	94
153	.313	.407	59	73
155	.247	.374	82	101
156	.266	.542	59	99
158	.283	.427	64	70

TABLE XVII TREADMILL TEST SYSTOLIC TIME INTERVALS

SUBJ	PEP/LVET Pre-TMX	PEP/LVET Post	HR-INST Pre-TMX	HR-INST Post
1				
4				
5				
6				
7				
8				
9				
15				
16	.210	.415	69	105
18	.306	.209	78	134
19	.248	.793	108	135
20	.285	.546	55	122
21	.205	.475	65	130
23	.270	.134	59	128
24	.309	.527	77	154
25	.278	.370	84	157
26				
27	.263	.186	82	116
28	.335	.458	69	121
29	.248	.312	82	152
31				
32	.206	.316	84	121
33	.223	.554	74	132
34	.271	.317	71	112
35	.311	.197	57	120
36				
38	.327	.189	71	135
41	.206	.330	64	115
43				
48	.332	.281	52	137
49	.274	.223	68	147
50	.329	.422	86	137
51	.301	.764	67	116
52	.349	.307	80	139
53	.318	.354	91	142
54	.259	.220	71	110
56				
57	.371	.213	81	101
58	.286	.553	65	101
59				
60				
61	.299	.458	78	115
62	.240	.166	74	100
63	.252	.220	77	120
64	.312	.215	95	121
65	.256	.232	59	114
66	.301		81	
67	.329	.207	51	109
68				

TABLE XVII TREADMILL TEST SYSTOLIC TIME INTERVALS

SUBJ	PEP/LVET		HR-INST	
	Pre-TMX	Post	Pre-TMX	Post
69	.213	.689	58	103
70	.231		80	
72	.327	.308	70	116
73	.305	.210	83	117
74	.322	.236	61	115
75	.299	.235	82	125
76	.296	.176	72	114
77	.259	.338	87	136
78	.307	.195	68	121
80	.277	.347	75	128
81	.314	.281	77	112
83	.313	.338	75	95
84	.216	.218	111	141
85				
86				
87				
88	.298	.532	67	104
90	.284	.323	55	92
91	.269	.243	67	115
92	.328	.327	66	91
93	.298	.177	66	131
94	.235	.376	72	98
96	.264	.231	78	112
97	.274	.253	68	109
98	.257	.254	60	111
100	.199	.184	48	76
101	.398	.216	66	97
102	.360	.250	63	101
107	.337	.222	71	104
108	.298	.231	76	112
109	.417	.443	71	107
110	.296	.200	80	114
111	.234	.443	101	120
112	.262	.238	71	113
113	.258	.164	63	94
115	.266	.146	76	109
116				
117				
118	.239	.256	89	124
123	.224	.258	64	102
124	.418	.246	91	109
127	.185	.543	90	132
144	.317	.228	81	123
146	.243	.305	55	101
147	.293	.245	69	109
153	.311	.175	61	112
155	.224	.204	84	116
156	.244	.191	66	112
158	.259	.134	67	135

TABLE XVIII LBNP AND TREADMILL STRESS TEST RESPONSES

PERCENTAGE CHANGES: 100 x (MAX-REST REFERENCE)/REST REFERENCE

SUBJ	HEART RATE		SYSTOLIC BP		DIASTOLIC BP		STI RATIO	
	LBNP	TMX	LBNP	TMX	LBNP	TMX	LBNP	TMX
1	12	88	-2		2			
4	23	91	-9	35	-2		30	
5	11	81	4	55	9	-3	-6	
6	14	79	7		22		22	
7	12	129	-12	104	-5	-17	80	
8	31	98	-11	98	-14	-6	28	
9	21	149		94	4		39	
15	35	160	-10	38			115	
16	23	80	18	23	22		81	98
18	44	67	-12	34	-2	-12	95	-32
19	20	44	-6	12	3	-18	38	220
20	13	185	-1	73	1	-27	4	92
21	26	152	-6				80	132
23	11	128		36	6	8	22	-50
24	5	104	-25	32	-4		-9	71
25	11	42	-6	50	4	-19	63	33
26	20	103	-3	59	-8	2	51	
27	13	64	-2	76	5	9	57	-29
28	30	139	-10	46	5	18	36	37
29	35	128	-9	46	-8	5	74	26
31	13	101	-17	23	-4	13	49	
32	23	78	-6	10	6	17	64	53
33	29	112	-10	26	2	5	102	148
34	27	85	-10	32	2	8	49	17
35	16	137	-10	48			41	-37
36	9	186	1	53	7	23	34	
38	10	125	-5	54	-8	-1	8	-42
41	23	119	-11	37	-8	17	76	60
43	17	56	-15	23	-8	-28	81	
48	30	170	-8	55	2	-7	28	-15
49	3	115	-4	36		4	54	-19
50	7	67	-9	13	-5	-5	31	28
51	19	85	-5	41	25		36	154
52	18	114	-8	17	4	3	55	-12
53	20	79	-14	43	-6	15	48	11
54	14	126	-9	36	2	20	41	-15
56	23	71	-13	40	5	11	3	
57	20	97	-1	55		25	56	-43
58	26	110	-7	71	3		64	93
59	10	110	-8	68	1	14	-14	
60		134		40	8	-32		
61		123	-2	38	-13		29	53
62		107	-3	42	5	16	36	-31
63	8	99	-5	22		5	48	-13
64	29	60	-8	25	3		46	-31
65		171	-4	47	2	5	67	-9
66	17	82	-4	22	2	-3	53	
67	22	162	-4	44	-4	-1	13	-37
68	26	96	-11	41	6			

TABLE XVIII LBNP AND TREADMILL STRESS TEST RESPONSES

PERCENTAGE CHANGES: 100 x (MAX-REST REFERENCE)/REST REFERENCE

SUBJ	HEART RATE		SYSTOLIC BP		DIASTOLIC BP		STI RATIO	
	LBNP	TMX	LBNP	TMX	LBNP	TMX	LBNP	TMX
69	12	106	8	26	6	-13	24	223
70	6	98	-3	15	-1	22	51	
72	29	102	-11	56	6		45	-6
73	12	102	-7	34	-2		35	-31
74	23	153	-12	17	-5		12	-27
75	20	87	-10	40	-2	8	44	-21
76	17	132			13		34	-41
77	7	108	-9	27	-7	-13	55	31
78	36	102	-2	82	2	3	53	-36
80	7	115	-5				35	25
81	17	98	-7	34	-2		46	-11
83	9	128	-9	12	3		59	8
84	18	58	-3	7	8		23	1
85	1	105	14		-6		25	
86	49	81	-9	67	-5	15		
87	23	116	-9	38	1	50	37	
88	4	111	-10	12	-14		24	79
90	6	141	-6	37	3	6	48	14
91	24	129	-16		3		33	-10
92	10	119		41	-1	19	51	
93	32	189	-2	47	13	-21	57	-41
94	9	120	-6	75	-8		27	60
96	34	72	-20	60	-9	4	91	-13
97	22	116		55	10	8	29	-8
98	20	146	-8	50	2	14	40	-1
100	45	155	-15	45	-12	-12	60	-8
101	16	110	-1	42	11		30	-46
102	16	130	-1	52	3		14	-31
107	7	127	-2	98	15	19	27	-34
108	27	101	-2		8		33	-22
109	24	79	-11	96	-5	5	66	6
110	25	84	5	60	14	9	55	-32
111	11	65	-7	34	5		71	89
112	8	133	-12		-4		48	-9
113	16	118	2	43	16	-21	39	-36
115	19	88	-5	34	4	11	35	-45
116	13	142	-7	65	5	12	114	
117	37	109	-11	112	6			
118	22	77	-9	44	4		63	7
123	8	147	-7	52		25	39	15
124	16		-22	30	-15	-8	31	-41
127	4	35	-14	63	-9	9	33	194
144	34	117	-4	30	6	-15	31	-28
146	14	177	-12	60	-15	27	63	26
147	32	102	-14		-7		36	-16
153	15	130	-8	42			30	-44
155	23	98	-3		6		51	-9
156	48	126	-5	81	9	3	104	-22
158	20	138	-8	52	5	21	51	-48

TABLE XIX DOUBLE PRODUCTS

SUBJ	DPSUNP	DPSUTM	DPLBNP	DPSTN	DPTMX	DP2	DP5
1	7623	6566	8342	10080		10528	9476
4	9976	7008	11236	11115	28598	21625	15336
5	6319	5760	7347	9167	25760	20111	10904
6	9360	8910	11433	12870		17097	11872
7	9576	9828	9435	9120	42456	13871	10146
8	8560	9592	9975	9858	38640	14042	10506
9	7300	7840	8800	7725	37400	17632	12000
15	5934	5568	7161	5880	21112	13530	9025
16	6090	6664	8858	9858	21710	13804	9120
18	7098	7777	8960	11227	25116	18513	12272
19	9672	13936	10976	16958	27280	20770	15730
20	5238	5830	5856	6300	31122	23064	12220
21	7560	7820	8888	8378		20587	12177
23	5985	6720	6650	8453	26280	19040	12765
24	7488	8160	5904	10545	28324	27632	15494
25	10355	9690	10815	18904	40392	24600	18492
26	7252	7220	8455	9828	31820	19180	15162
27	8415	7600	9312	9120	26219	17040	12566
28	7665	6936	8930	7828	27300	17040	11200
29	8640	8240	10584	10416	34768	18369	13818
31	10032	7326	9405	11520	28564	18228	12826
32	9483	9396	11021	15232	29850	22540	12420
33	6300	6674	7372	8170	21840	18216	12402
34	6660	6480	7614	8924	21760	11960	7654
35	7245	7068	7519	7884	27680	19936	12549
36	5280	4600	5820	6174	27000	18758	10962
38	7227		7520	7885	27302	16254	10192
41	5952	6204	6460	9240	27792	22016	12036
43	10062	11480	10100	17061	32886	24795	16988
48	4482	4743	5320	6580	27594		10670
49	8496	7236	8362	12460	36290	24656	14985
50	11328	9877	11021	12650	23920	24780	14672
51	6956	6666	7832	10434	27144	18705	13080
52	9877	9102	10682	10701	26784	22922	17112
53	9744	10340	10100	13224	33864	22419	15750
54	7600	7452	7917	9976	30652	20570	17549
56	6699	6930	7220	10200	24360	17040	10476
57	7533	7560	8924	8924	27150	12120	8811
58	7350	6080	8624	8281	29796	23244	14175
59	7632	7480	7663	8715	30624	22052	14784
60	7571	7616	7571	8662	28386	16206	12384
61	8927	8378	8769	8687	26732	22072	13775
62	6956	7560	6734	7800	22940	14140	9345
63	7904	8528	8118	11253	27380	17556	12705
64	9555	10146	11349	13104	26180	23226	19250
65	8220	7936	7860	9009	35910	25080	18537
66	8023	10707	8964	16568	36828	22250	20460
67	5723	5244	6696	6804	25575	19932	9379
68	6696	6674	7553	8424	23256	13500	10340

TABLE XIX DOUBLE PRODUCTS

SUBJ	DPSUNP	DPSUTM	DPLBNP	DPSTN	DPTMX	DP2	DP5
69	5073	6254	6144	10665	27710	23904	11102
70	7128	7425	7296	12328	28028		13420
72	6624	6700	7565	9568	30132	25256	13734
73	6864	7954	7134	8536	23140	20034	13407
74	7930	7808	8560	8610	25488	23925	12730
75	8568	8160	9292	10486	27450	21804	14508
76	7038	7236	8262	9558		25810	15984
77	9680	8362	9400	9792	26000	24070	15250
78	6132	5508	8118	8360	30720	23800	12654
80	9072	8346	9222	9879		27018	18228
81	7854	8800	8550	10620	28124		13886
83	10112	7797	10062	9500	24220	19500	14100
84	12036	14750	13800	19481	33043		20960
85	7904	8214	9163	11205		22344	15582
86	8148	8134	11000	10272	31040	24070	13310
87	7107	7480	7990	10324	30720	24420	13920
88	8023	8442	7548	12300	29064		17836
90	6110	6608	6072	8804	29070	14170	8320
91	6674	7150	6952	8232		20930	12740
92	5952	6080	6528	7140	22032	14948	8798
93	6324	5760	8200	8050	34138	17380	11368
94	8190	6460	8360	7104	27384	20160	11562
96	9064	7476	9676	10864	29915	25551	11881
97	6097	6534	7462	7068	23616	15290	12750
98	6464	6464	7161	8588	31790	21140	13289
100	4134	4018	5082	5824	21516	16500	8103
101	5952	6016	6808	8528	25456	18487	9167
102	6365	5642	7332	8295	29120	18330	
107	6205	5832	6474	6561	29440	19966	12566
108	6660	6460	8272	8526		19110	10816
109	7979	6762	8820	9700	34010	22304	12096
110	8500	7600	11130	10812	31785	24585	15510
111	9310	10504	9555	11865	26226	21804	14280
112	7670	8556	7280	8968			14351
113	6400	6882	7548	7918	24633	19782	11374
115	8568	11398	9718	12835	32320	24640	13832
116	5504	7168	5760	7904	31648		8918
117	7800	7290	9579	9360	41360		13440
118	8976	9416	9951	12688	32384	19926	13915
123	6695	8320	6720	7665	28800	19320	11186
124	9975	9828	9020		26752		11544
127	7462	9405	6630	13340	29400	22294	13054
144	9006	10240	11554	10375	29160	23850	13260
146	5796	4806	5832	6100	27040	20160	7725
147	6969	7072	7917	8938		19180	11600
153	5394	6138	5680	8216	26936	18942	11660
155	8400	9434	9996	10246		14715	9894
156	5612		7830	7680	31494	19440	12524
158	5874	7840	6478	7676	27874	19728	11021

TABLE A1: SUMMARY STATISTICS

DESCRIPTIVE VARIABLES

Variable	N	Mean	SE	Min	Max
age (yrs)	98	34.3	1.02	20	61
height (cm)	98	164.8	0.55	150.0	180.0
weight (kg)	98	60.0	0.84	45.4	84.3
body surface area (sq m)	98	1.66	0.012	1.41	1.92
oral temp. (deg F)	98	98.1	0.04	97.4	99.6
room temp. (deg F)	96	72.6	0.18	67.0	78.0
menst. cycle length (days)	71	28.7	0.28	21	40
day of menst. cycle	71	0.49	0.024	0	0.97
amt. of sleep (hrs)	98	7.2	0.12	5.0	12.0
time since eating (hrs)	98	10.3	0.53	1.0	21.0
hgb (gm %)	98	13.0	0.10	10.1	15.4
hct (%)	98	40	0.30	28	46
cholesterol (mg %)	98	208.2	4.17	117	297
triglyceride (mg %)	98	88.0	3.49	37	198
FEV1 (l)	93	3.05	0.05	1.80	4.16
FVC (l)	93	3.69	0.06	2.35	5.25
FEV1/FVC (%)	93	82.5	0.81	50	97
VC (l)	93	3.57	0.06	2.38	5.31
SBP, clinical (mm Hg)	96	106.3	1.32	80	150
DBP, clinical (mm Hg)	96	70.3	0.89	50	90
exercise category	96	1.75	0.07	1	3

TABLE A2: SIGNIFICANT CORRELATIONS BETWEEN DESCRIPTIVE VARIABLES ($p < 0.05$)

Independent Variable	Dependent Variable	Slope	Intercept	r
age	SBP, clinical	0.42	92.27	.27
	oral temp.	-0.009	98.42	-.22
	room temp.	-0.04	73.95	-.23
	time since eating	-0.19	16.67	-.36
	cholesterol	1.19	167.58	.29
	FEV1	-0.02	3.58	-.32
	FEV1/FVC	-0.40	95.97	-.50
height	weight	0.54	-29.49	.37
	body surface area	0.01	-0.66	.63
	FEV1	0.04	-3.11	.41
	FVC	0.06	-5.75	.54
	VC	0.06	-6.76	.61
weight	body surface area	0.01	0.86	.93
	SBP, clinical	0.35	85.68	.23
	DBP, clinical	0.28	53.85	.26
	triglyceride	1.20	16.09	.30
	FVC	0.02	2.43	.30
	FEV1/FVC	-0.21	95.26	-.50
	VC	0.02	2.31	.32
body surface area	triglyceride	64.01	-18.24	.22
	FEV1	0.90	1.56	.22
	FVC	1.82	0.67	.38
	FEV1/FVC	-14.42	106.46	-.22
	VC	1.99	0.26	.43
	SBP, clinical	27.04	61.35	.25
	DBP, clinical	20.83	35.67	.29
cycle length	DBP, clinical	-1.04	98.98	-.24
hgb	hct	2.66	5.07	.90
cholesterol	triglyceride	0.23	40.99	.27
FEV1	FVC	0.92	0.87	.79
	VC	0.71	1.40	.63
FVC	VC	0.84	0.48	.86
FEV1/FVC	VC	-0.02	5.13	-.27
SBP, clinical	DBP, clinical	0.48	19.52	.70
	triglyceride	0.54	30.63	.20

TABLE B1: SUMMARY STATISTICS

LBNP TEST VARIABLES

	N	Mean	SE	Min	Max
HR, supine (bpm)	98	74.2	1.05	53	102
HR, maximal (bpm)	98	87.9	1.46	60	125
SBP, supine (mm Hg)	98	101.7	1.14	78	137
DBP, supine (mm Hg)	98	66.8	0.93	47	91
SBP, maximal (mm Hg)	98	95.2	1.16	66	131
DBP, maximal (mm Hg)	98	67.4	0.91	43	93
PEP/LVET, rest	93	0.292	0.0049	0.185	0.401
PEP/LVET, maximal	93	0.419	0.0075	0.260	0.622
left calf circ. (cm)	98	34.0	0.25	28.5	41.2
right calf circ. (cm)	98	34.1	0.25	29.2	41.9
change LLV (%)	98	1.4	0.07	0.2	5.5
change RLV (%)	97	1.4	0.07	0.4	4.9
LLV (ml)	94	7443.1	118.0	5054	11021

TABLE B2: SIGNIFICANT CORRELATIONS BETWEEN LBNP TEST VARIABLES ($p < 0.05$)

Independent Variable	Dependent Variable	Slope	Intercept	r
HR, supine	SBP, supine	0.36	75.34	.33
	change RLV	-0.02	2.90	-.29
	HR, maximal	1.17	1.42	.84
HR, maximal	PEP/LVET, maximal	0.002	0.29	.29
SBP, supine	DBP, supine	0.62	4.15	.75
	SBP, maximal	0.85	8.67	.83
	DBP, maximal	0.52	14.72	.65
	left calf circ.	0.05	28.75	.24
	right calf circ.	0.05	28.69	.24
	LLV	22.62	5143.00	.22
DBP, supine	SBP, maximal	0.86	37.85	.69
	DBP, maximal	0.82	12.37	.85
	left calf circ.	0.08	28.71	.30
	right calf circ.	0.08	28.46	.32
	LLV	36.34	5014.69	.29
SBP, maximal	DBP, maximal	0.60	10.55	.77
	left calf circ.	0.04	29.94	.20
	LLV	22.00	5355.77	.22
DBP, maximal	left calf circ.	0.11	26.81	.39
	right calf circ.	0.11	26.75	.40
	LLV	50.73	4029.23	.40
PEP/LVET, rest	PEP/LVET, maximal	0.77	0.20	.50
	change LLV	-4.27	2.64	-.24
left calf circ.	right calf circ.	0.98	0.79	.97
	LLV	362.46	-4894.17	.78
right calf circ.	LLV	355.09	-4664.42	.76
change RLV	HR, maximal	-4.07	93.75	-.20
change LLV	change RLV	0.41	0.86	.46
LLV	change RLV	-0.0001	2.52	-.23

TABLE C1: SUMMARY STATISTICS

TREADMILL TEST VARIABLES

	N	MEAN	SE	MIN	MAX
HR, supine (bpm)	97	73.1	1.20	49	118
HR, standing (bpm)	97	88.1	1.66	60	145
HR, hypervent. (bpm)	95	132.3	2.24	86	190
HR, maximal (bpm)	98	180.5	1.20	153	212
HR, 2-min rec. (bpm)	98	134.5	2.08	94	180
HR, 5-min rec. (bpm)	98	104.1	1.25	73	138
SBP, supine (mm Hg)	97	104.4	1.27	80	140
DBP, supine (mm Hg)	98	67.3	1.06	46	92
SBP, standing (mm Hg)	98	111.2	1.60	81	161
DBP, standing (mm Hg)	98	74.6	1.06	50	97
SBP, maximal (mm Hg)	87	159.7	2.28	116	232
DBP, maximal (mm Hg)	66	76.4	1.32	50	99
SBP, 2-min rec. (mm Hg)	89	150.5	2.18	112	237
DBP, 2-min rec. (mm Hg)	82	65.8	1.47	29	98
SBP, 5-min rec. (mm Hg)	97	122.9	1.74	89	182
DBP, 5-min rec. (mm Hg)	93	63.3	1.06	42	89
PEP/LVET, rest	77	0.283	0.0056	0.185	0.418
PEP/LVET, maximal	75	0.306	0.0165	0.134	0.764
VO2 peak (ml/kg/min)	92	30.4	0.65	18.5	50.4
duration of exercise	98	9.3	0.2	6.0	15.1

TABLE C2: SIGNIFICANT CORRELATIONS BETWEEN TREADMILL TEST VARIABLES ($p < 0.05$)

Independent Variable	Dependent Variable	Slope	Intercept	r
HR, supine	SBP, supine	0.33	80.53	.31
	SBP, standing	0.44	79.11	.33
HR, standing	SBP, standing	0.21	92.94	.21
	PEP/LVET, maximal	0.002	0.14	.23
HR, hypervent.	VO2 peak	0.06	22.05	.22
HR, maximal	VO2 peak	0.26	-17.14	.51
HR, 2-min rec.	VO2 peak	0.12	14.61	.38
HR, 5-min rec.	SBP, 5-min rec.	0.53	67.42	.39
	VO2 peak	0.17	12.66	.33
SBP, supine	HR, 5-min rec.	0.34	68.72	.34
DBP, supine	HR, 5-min rec.	0.24	88.04	.20
SBP, standing	HR, 5-min rec.	0.28	73.32	.35
SBP, 2-min rec.	HR, 5-min rec.	0.15	81.30	.25
SBP, 5-min rec.	VO2 peak	0.10	17.70	.28
dur. of exercise	HR, maximal	3.42	148.87	.57
	HR, 5-ein rec.	1.56	89.69	.25
	SBP, 2-min rec.	2.52	127.03	.25
	DBP, 5-min rec.	-1.42	76.45	-.28
	VO2 peak	2.09	11.01	.66

TABLE D: SIGNIFICANT CORRELATIONS BETWEEN LBNP TEST VARIABLES AND SELECTED DESCRIPTIVE VARIABLES ($p < 0.05$)

Independent Variable	Dependent Variable	Slope	Intercept	r
age	HR, supine	-.25	82.66	-.24
	HR, maximal	.52	105.69	-.37
	DBP, supine	.25	58.14	.27
	SBP, maximal	.31	84.43	.27
	DBP, maximal	.26	58.35	.30
height	left calf circ.	.09	18.56	.23
	right calf circ.	.09	18.90	.22
	LLV	89.50	-7309.03	.43
weight	left calf circ.	.24	19.53	.82
	right calf circ.	.24	19.76	.81
	LLV	100.43	1389.84	.73
	SBP, supine	.35	80.42	.24
	DBP, supine	.34	46.61	.30
	DBP, maximal	.42	41.72	.37
oral temp.	HR, supine	8.29	-738.72	.28
	HR, maximal	9.74	-867.62	.24
room temp.	DBP, supine	-1.12	148.02	-.21
menstrual day	DBP, maximal	-9.43	71.06	-.25

TABLE E: SIGNIFICANT CORRELATIONS BETWEEN TREADMILL TEST VARIABLES AND SELECTED DESCRIPTIVE VARIABLES ($p < 0.05$)

Independent Variable	Dependent Variable	Slope	Intercept	r
age	HR, supine	-0.28	81.71	-.21
	HR, standing	-0.54	105.75	-.35
	HR, hypervent.	-0.89	158.97	-.42
	HR, maximal	-0.78	206.89	-.60
	HR, 5-min rec.	-0.40	117.78	-.32
	DBP, supine	0.26	58.29	.26
	DBP, standing	0.23	26.75	.22
	DBP, 2-min rec.	0.34	54.66	.27
	DBP, 5-min rec.	0.31	52.54	.26
	VO2	-0.24	38.92	-.34
body surface area	HR, stand	-43.50	160.41	-.23
	DBP, supine	26.37	22.55	.34
	DBP, maximal	37.04	15.70	.39
menstrual day	HR, 2-min rec.	-20.48	145.76	-.24
	HR, 5-min rec.	-10.51	112.06	-.24
VC	VO2	3.35	18.49	.31
exercise cat.	VO2	2.68	25.42	.32
	dur. of exercise	0.31	8.51	.32

TABLE F: SELECTED SIGNIFICANT CORRELATIONS BETWEEN TREADMILL AND LBNP TEST VARIABLES ($P < 0.05$)

Independent Variable (LBNP)	Dependent Variable (Treadmill)	Slope	Intercept	r
HR, supine	HR, supine	.99	-.22	.86
	HR, standing	1.32	-9.27	.81
	HR, hypervent.	1.05	54.11	.50
	HR, maximal	.45	147.17	.36
	HR, 2-min rec.	.51	98.31	.21
	HR, 5-min rec.	.79	45.59	.62
	SBP, supine	.29	82.76	.23
	SBP, standing	.38	83.71	.25
HR, maximal	HR, supine	.60	20.62	.73
	HR, standing	.84	14.90	.73
	HR, hypervent.	.65	74.76	.44
	HR, maximal	.37	148.19	.42
	HR, 5-min rec.	.44	66.26	.49
SBP, maximal	SBP, standing	.90	25.94	.65
DBP, maximal	DBP, standing	.74	24.54	.64
left calf circ.	SBP, 5-min rec.	2.24	46.71	.25
	DBP, supine	1.60	12.94	.34
	DBP, standing	1.50	24.80	.28
	DBP, maximal	2.08	7.11	.39
right calf circ.	SBP, 5-min rec.	2.19	48.13	.25
	DBP, supine	1.62	12.07	.33
	DBP, standing	1.60	21.14	.29
	DBP, maximal	1.99	9.89	.38

TABLE G: SUMMARY STATISTICS ON DOUBLE PRODUCTS

Variable	N	Mean	Std Error	Minimum	Maximum
DP, supine before LBNP	98	7581.6	155.60	4134	12036
DP, supine before TMX	96	7705.0	183.45	4018	14750
DP, at maximal LBNP	98	8352.1	169.15	5082	13800
DP, at quiet standing	97	9850.8	268.53	5824	19481
DP, at maximal exercise	88	28856.5	479.43	21112	42456
DP, 2 minutes after TMX	89	20020.6	398.13	10528	27632
DP, 5 minutes after TMX	97	12883.6	282.58	7654	20960

TABLE NWA SELECTED DESCRIPTIVE STATISTICS OF NASA WOMEN ASTRONAUTS

DESCRIPTIVE VARIABLES

Variable	N	Mean	SD	S	M	Max
Age (years)	13	36.1	4.10	1.18	28	44
Height (cm)	13	166.5	5.33	1.54	157	175
Weight (kg)	13	59.5	8.07	2.33	47	74
Hemoglobin (g %)	14	13.0	1.07	.30	11.0	15.8
Hematocrit (%)	14	38.0	2.70	.75	34	45
Cholesterol (mg %)	14	182.8	34.75	9.64	123	250
Cholesterol/HDL Ratio	14	3.2	.52	.14	1.9	4.2
Triglycerides (mg %)	14	75.0	32.33	8.97	41	172
SBP, sitting (mm Hg)	12	105.2	5.97	1.80	98	118
DBP, sitting (mm Hg)	12	67.5	5.90	1.78	60	80
HR, maximal (bpm)	10	171.6	7.30	2.43	162	185
VO2 peak (ml/kg/min)	10	36.8	7.21	2.40	26	48

FIGURE L

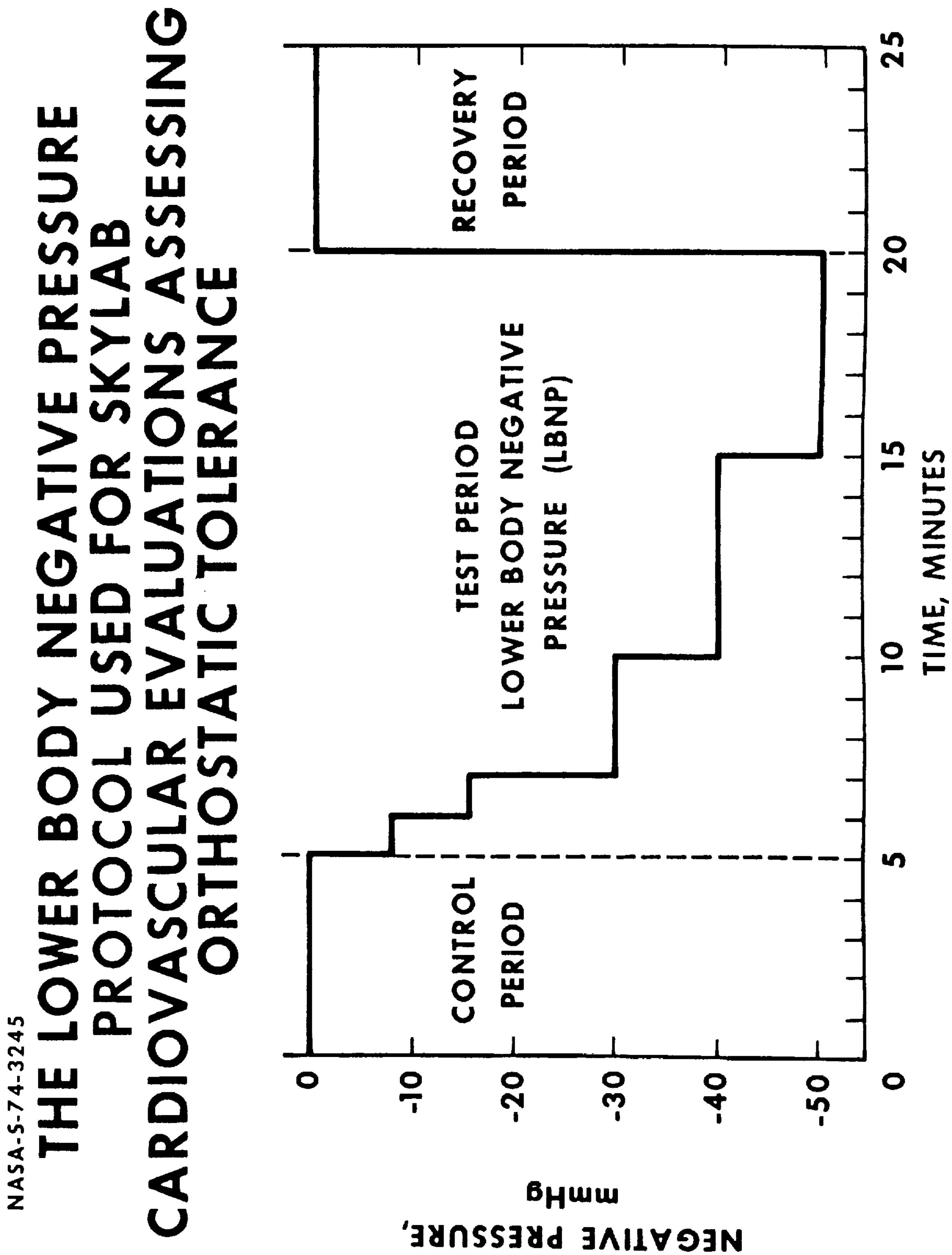

NASA-S-74-3245
THE LOWER BODY NEGATIVE PRESSURE PROTOCOL USED FOR SKYLAB CARDIOVASCULAR EVALUATIONS ASSESSING ORTHOSTATIC TOLERANCE
CONTROL PERIOD
TEST PERIOD
LOWER BODY NEGATIVE PRESSURE (LBNP)
RECOVERY PERIOD
NEGATIVE PRESSURE, mmHg
0
-10
-20
-30
-40
-50
TIME, MINUTES
0
5
10
15
20
25

FIGURE V

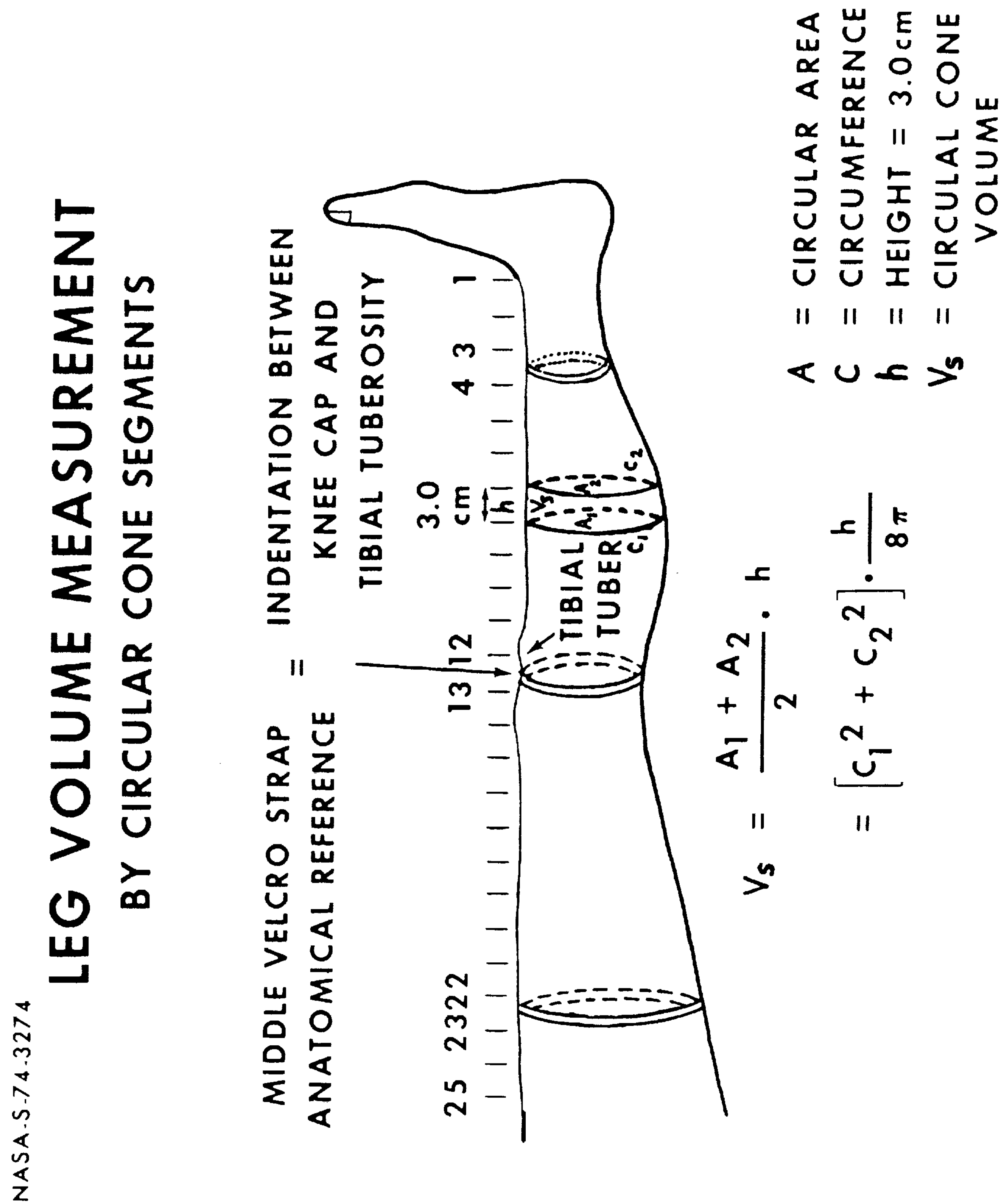
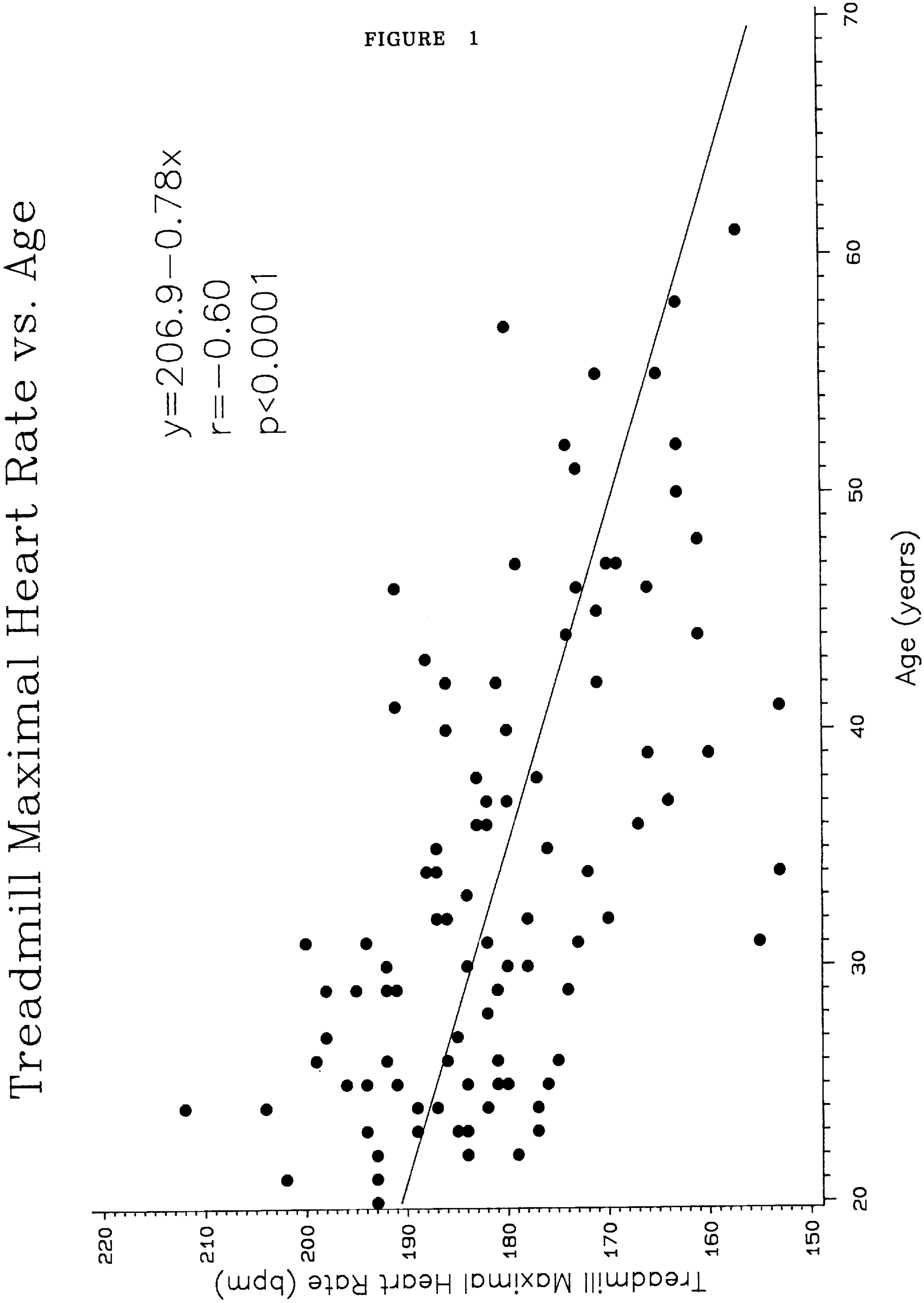

NASA-S-74-3274
LEG VOLUME MEASUREMENT
BY CIRCULAR CONE SEGMENTS
MIDDLE VELCRO STRAP = INDENTATION BETWEEN
ANATOMICAL REFERENCE KNEE CAP AND
TIBIAL TUBEROSITY
25 23 22
13 12
3.0 cm
h
4 3
1
TIBIAL TUBER
V_s A_1 A_2 C_1 C_2
$V_s = \frac{A_1 + A_2}{2} \cdot h$
$= \left[C_1^2 + C_2^2\right] \cdot \frac{h}{8\pi}$
A = CIRCULAR AREA
C = CIRCUMFERENCE
h = HEIGHT = 3.0cm
V_s = CIRCULAL CONE VOLUME

FIGURE 1



Treadmill Maximal Heart Rate vs. Age
y=206.9−0.78x
r=−0.60
p<0.0001
Treadmill Maximal Heart Rate (bpm)
220
210
200
190
180
170
160
150
Age (years)
20
30
40
50
60
70

FIGURE 2

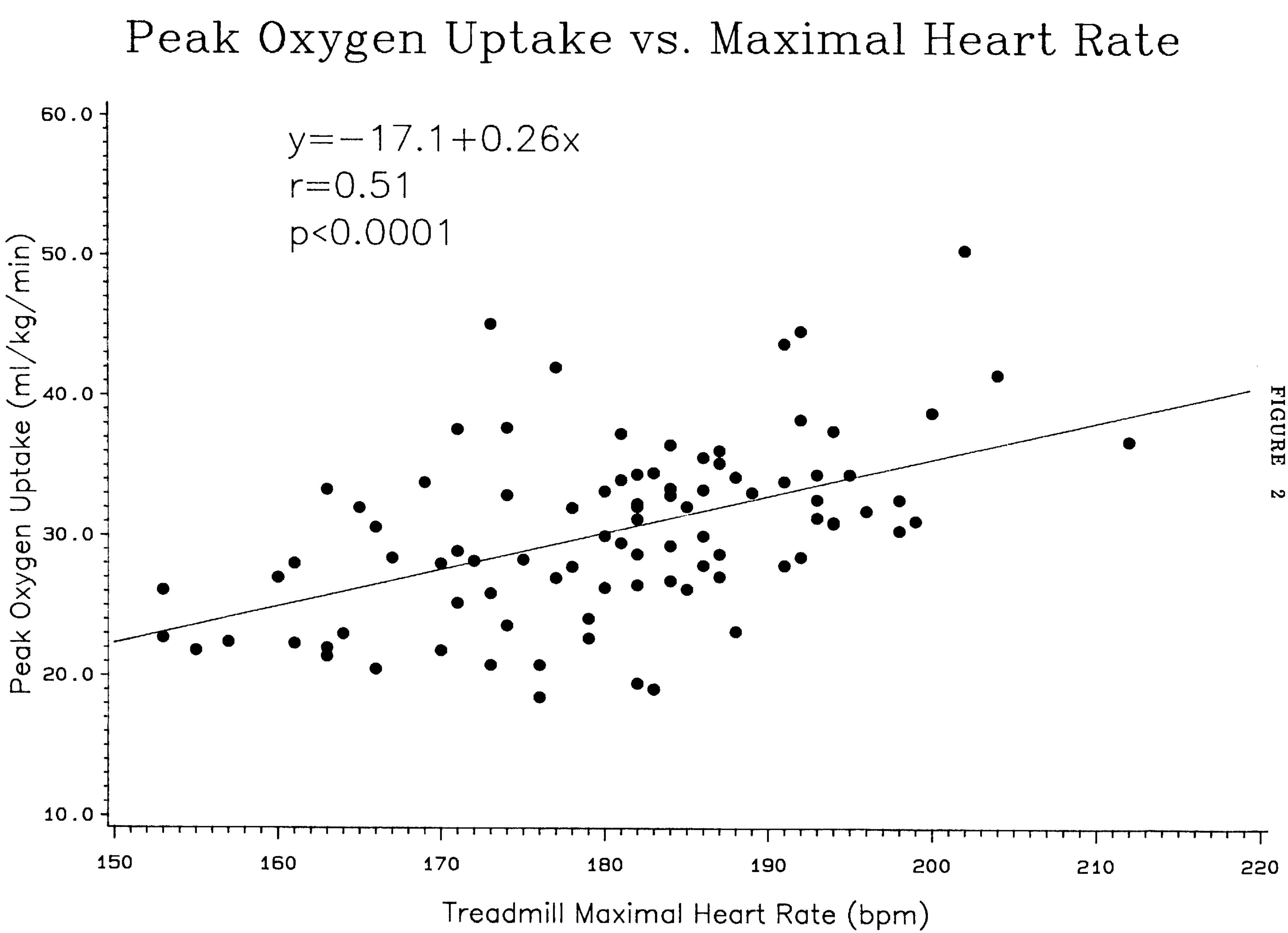
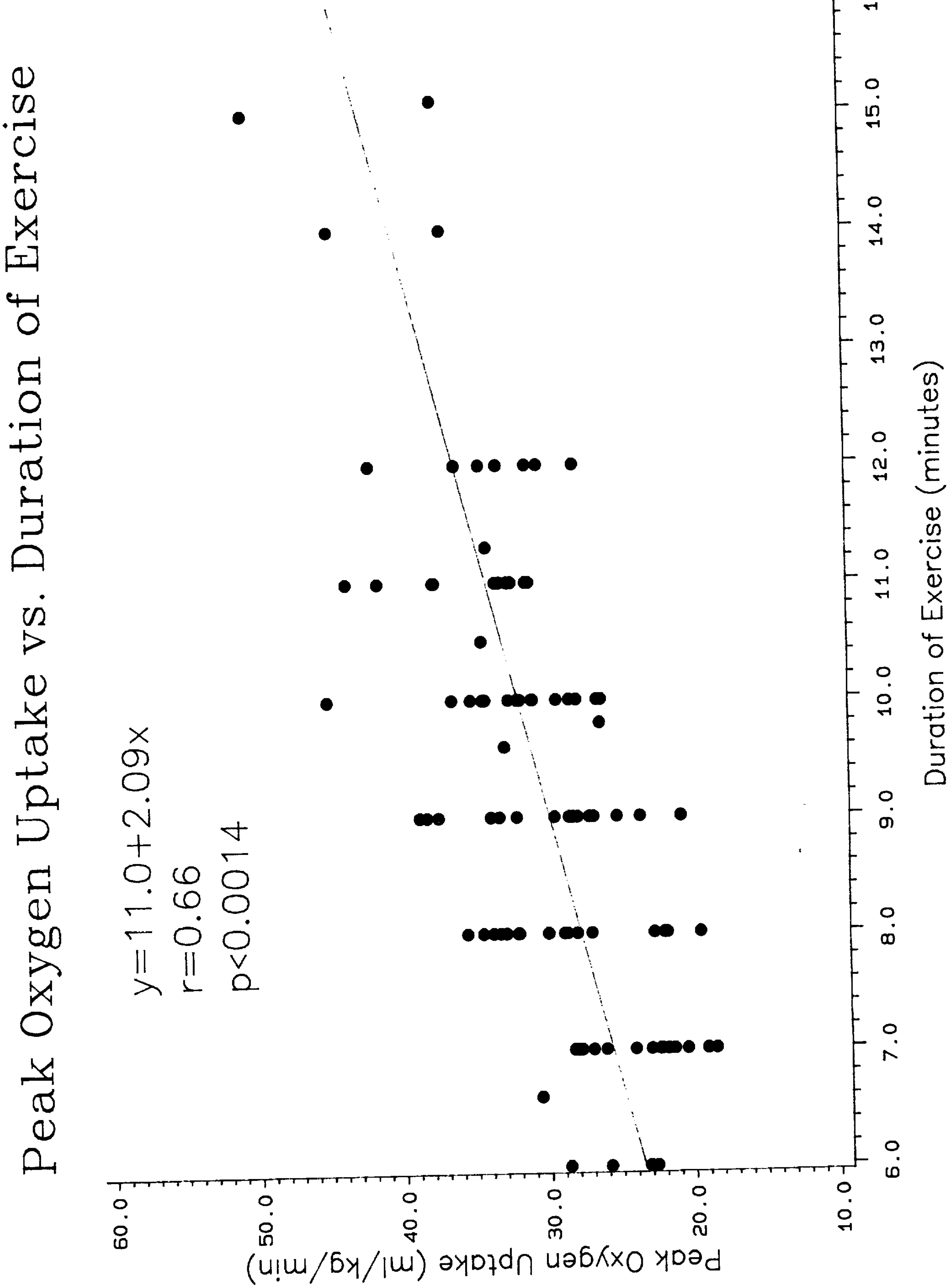

Peak Oxygen Uptake vs. Maximal Heart Rate
y=−17.1+0.26x
r=0.51
p<0.0001
Peak Oxygen Uptake (ml/kg/min)
60.0
50.0
40.0
30.0
20.0
10.0
150
160
170
180
190
200
210
220
Treadmill Maximal Heart Rate (bpm)

FIGURE 3



Peak Oxygen Uptake vs. Duration of Exercise
y=11.0+2.09x
r=0.66
p<0.0014
Peak Oxygen Uptake (ml/kg/min)
Duration of Exercise (minutes)
60.0
50.0
40.0
30.0
20.0
10.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0

LBNP (−50 mm Hg) Heart Rate vs. Standing Heart Rate

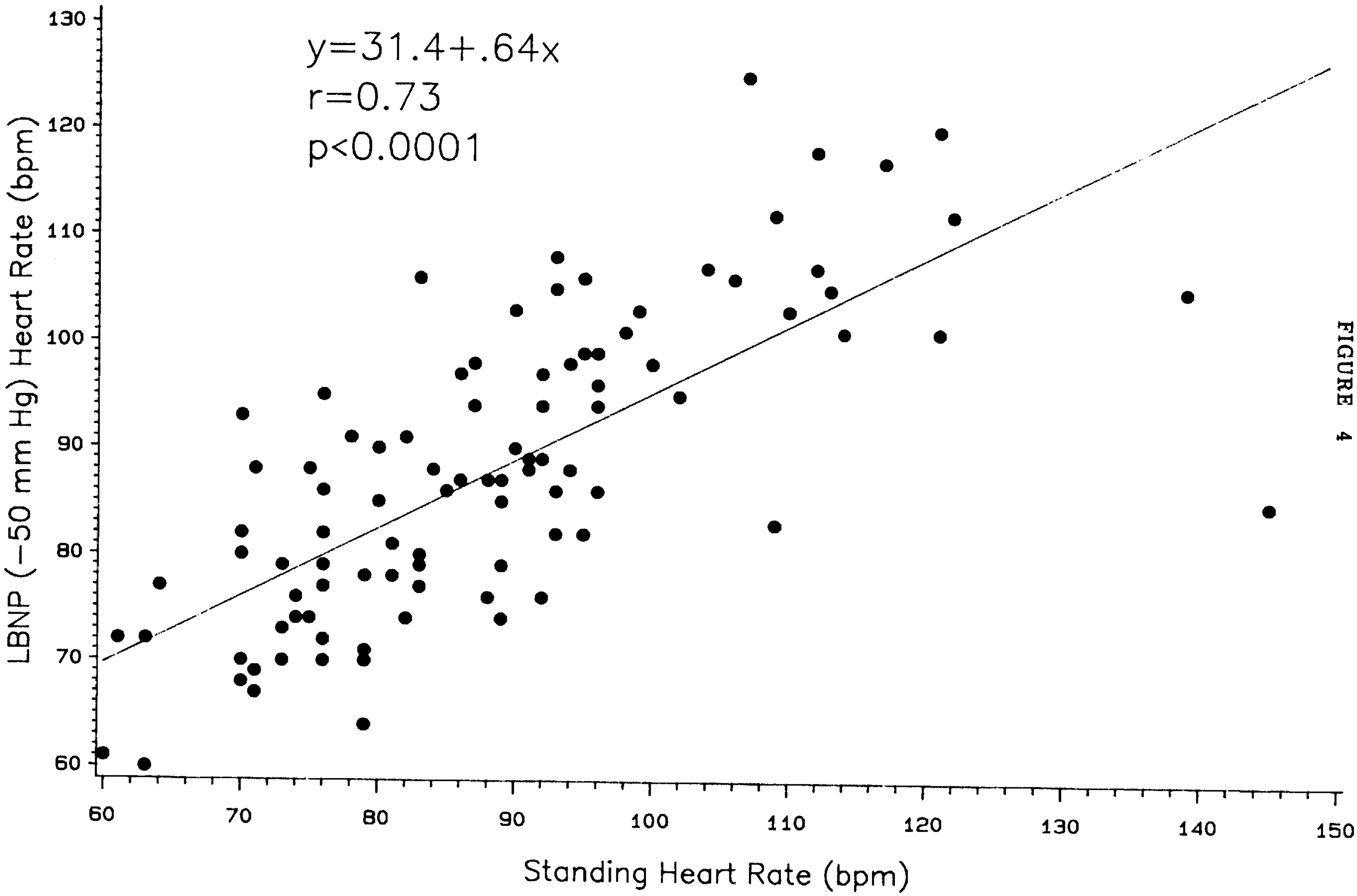


FIGURE 4

Systolic Blood Pressure during LBNP (−50 mm Hg) vs. Standing

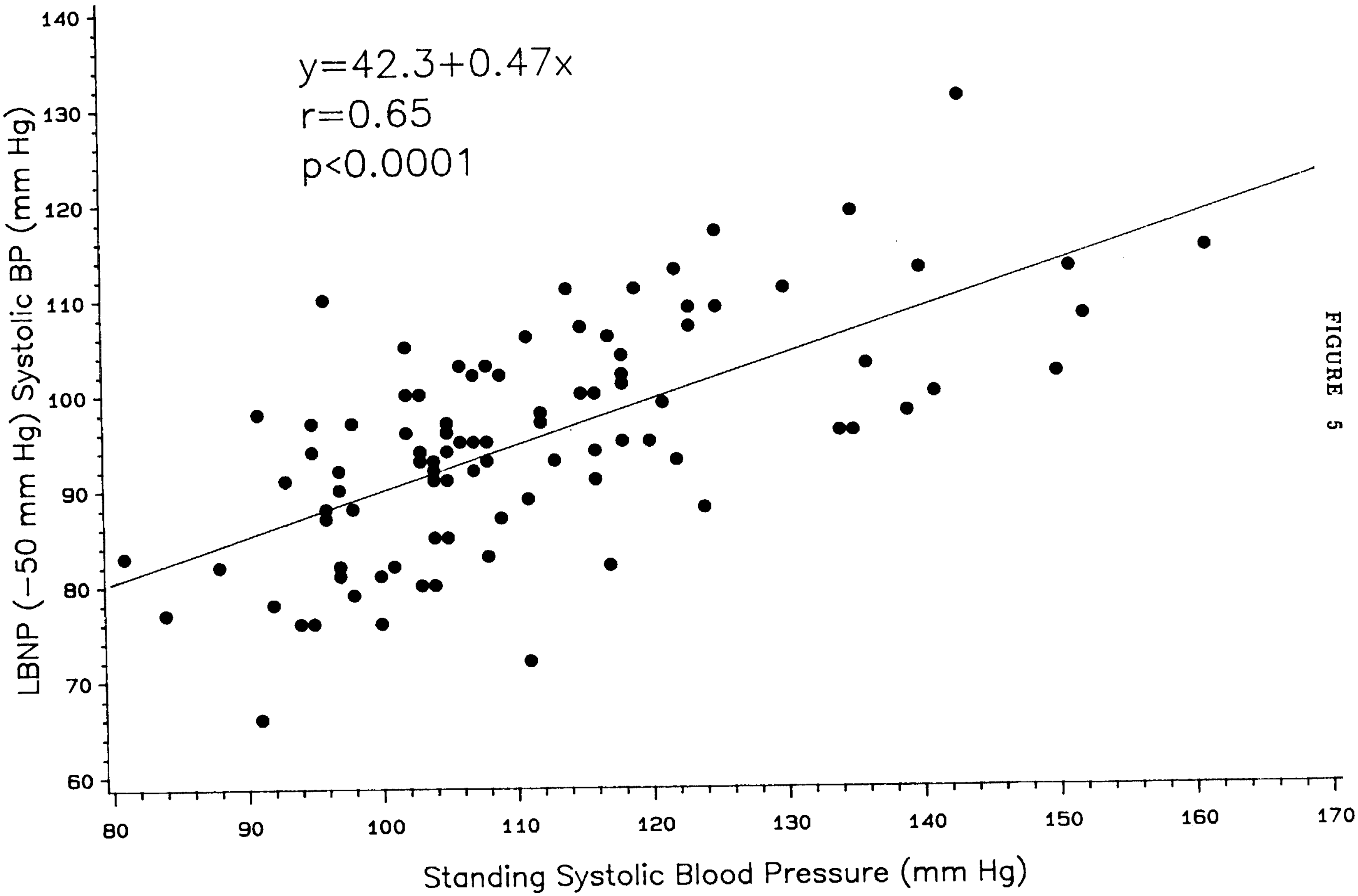


FIGURE 5

Mean Blood Pressure during LBNP (−50 mm Hg) vs. Standing

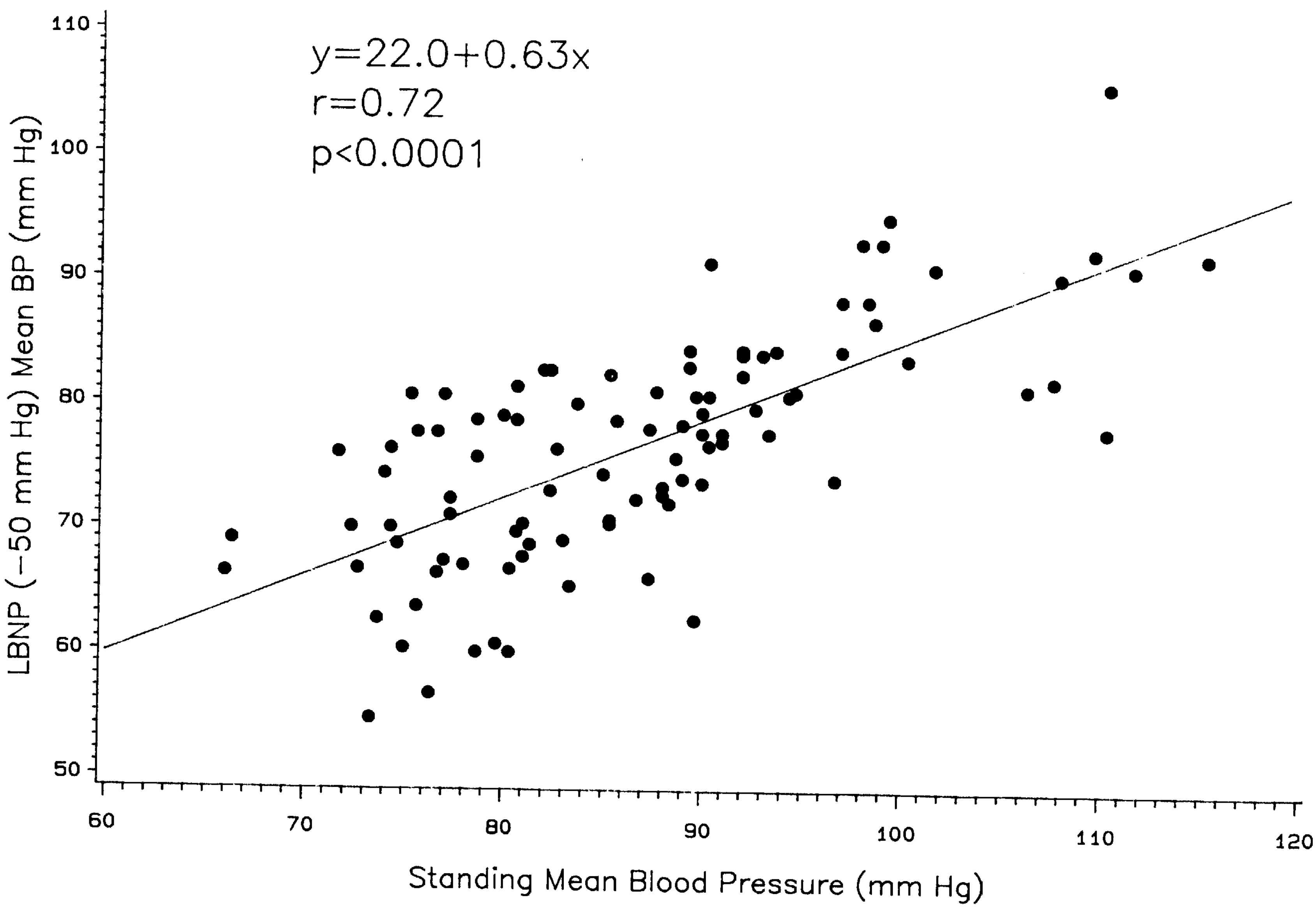


FIGURE 6

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16. Abstract
This technical report presents the results from a special physiological study of women performed at the Johnson Space Center in 1976-1977. Its purpose was to establish a large (98 subjects) database from normal working women. The data sets are medical historical, clinical, anthropometric, and stress response statistics useful for establishing medical criteria for selecting women astronauts. Stressors were lower body negative pressure and static standing (both orthostatic) and treadmill exercise (ergometric). Data shown are original individual values with analyses and subsets, and statistical summaries and correlations relating to human responses to microgravity. Similarities appear between the characteristics of women in this study and those of women astronauts currently flying in Shuttle crews.

17. Key Words (Suggested by Author(s)) Orthostatic, Exercise, Stress Response, LBNP, Treadmill, Women	18. Distribution Statement Unclassified - Unlimited Subject Category 52

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